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## CEREBRAL BLOOD FLOW PRECEDING AND ACCOMPANYING EPILEPTIC SEIZURES IN MAN

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That epileptic seizures are caused by cerebral anemia consequent to a cerebral vascular spasm is a widely accepted and plausible hypothesis. It is, moreover, one that bears the respectability of age. In 1861 Reynolds<sup>1</sup> in his book on epilepsy wrote:

M. Bernard has shown that after division of the sympathetic nerve in the neck there is an elevation of temperature and vascularity, not only in the superficial parts of the head, but in the cranial cavity and the cerebral substance itself. Again, Donders and Van der Beke Callenfells have proved that irritation of these nerves causes contraction in the arteries of the pia mater; and the same observers, together with Dr. Brown-Séquard, have demonstrated that arteries of the brain-meninges contract through reflex stimulation; the centre of such reflexion being the medulla oblongata. Now, it has been shown experimentally by Astley Cooper, that compression of the brain will induce loss of consciousness and epileptiform attacks: similar results of anemia have been abundantly witnessed in clinical experience; and lately, Kussmaul and Tenner have demonstrated the fact, and argued therefrom with great ability. There appears, therefore, no reason for doubting that the immediate cause of loss of consciousness is arrest of the cerebral circulation, owing to contraction of the vessels. . . .

Echeverria,<sup>2</sup> in 1870, devoted much space to supporting data for this theory. In 1889 Alexander<sup>3</sup> thought the evidence sufficient to warrant the removal of the cervical sympathetic in a series of epileptic patients.

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This paper is number XXX in a series entitled "The Cerebral Circulation" and number XIV in another series entitled "Studies in Epilepsy."

1. Reynolds, J. Russel: *Epilepsy: Its Symptoms, Treatment and Relation to Other Chronic Convulsive Diseases*, London, John Churchill, 1861.

2. Echeverria, G.: *On Epilepsy*, New York, William Wood & Company, 1870.

3. Alexander, W.: *The Treatment of Epilepsy*, Edinburgh, Y. J. Pentland, 1889.

There was not, however, universal acceptance of the theory of vasomotor spasm. Gowers,<sup>4</sup> whose book, published in 1901, is perhaps the most authoritative yet written on the subject, summed up his opinion as follows:

Thus between the fact that profound anemia of the brain and medulla oblongata will cause both loss of consciousness and convulsion, and the theory that these are commonly so caused in epilepsy, there is a gulf over which no bridge has yet been placed.

The state of knowledge regarding the subject has changed little since 1901. It is true that the work of Elsberg and Stookey<sup>5</sup> has cast doubt on the existence of a direct causal relation between cerebral anemia and convulsions. These investigators reported that the convulsions which develop in cats after the cerebral arteries have been ligated for a short period are prevented by perfusing the brain during the period of anemia with physiologic solution of sodium chloride. Later evidence has indicated that the unconsciousness and convulsions which Leonard Hill<sup>6</sup> produced in himself by the compression of one carotid were probably caused by a hyperactive carotid reflex and not, as he supposed, by occlusion of the carotid artery. Weiss and Baker<sup>7</sup> showed that the relationship between cerebral anemia and these manifestations of the carotid sinus reflex is not as simple as was at first supposed: Some patients who show the symptoms do not have a marked preliminary fall in heart rate or blood pressure. Syncope, with occasional convulsive manifestations, is frequently seen as a sequel to a sudden fall in blood pressure from whatever cause, whether from emotional shock, the assumption of an upright position, heart block or paroxysmal tachycardia. This is cited as evidence that generalized cerebral anemia may be the cause of seizures in the usual epileptic patient. Our observation that syncope can be induced in an epileptic patient without causing him to have one of his usual convulsive seizures, is against such a conclusion.

Forbes<sup>8</sup> and his associates accumulated much evidence in recent years to support the contention of earlier workers that the cerebral vessels are under nervous control. Stimulation of cervical sympathetic nerves causes constriction, and stimulation of vagus nerves, dilation of

4. Gowers, William R.: *Epilepsy and Other Chronic Convulsive Diseases*, ed. 2, London, J. & A. Churchill, 1901.

5. Elsberg, C. A., and Stookey, B. P.: *Studies on Epilepsy*, Arch. Neurol. & Psychiat. **9**:613 (May) 1923.

6. Hill, Leonard: *The Physiology and Pathology of Cerebral Circulation*, London, J. & A. Churchill, 1896.

7. Weiss, S. and Baker, J. P.: The Carotid Sinus Reflex in Health and Disease, *Medicine* **12**:297, 1933.

8. Forbes, H. S., and Wolff, H. G.: Vasomotor Control of Cerebral Blood Vessels, Arch. Neurol. & Psychiat. **19**:1057 (June) 1928.



pial vessels. Penfield<sup>9</sup> has demonstrated nerve endings on the cerebral blood vessels, so that a structural basis for a cerebral vasomotor mechanism is no longer lacking. Wolff and Lennox<sup>10</sup> and Lennox and E. L. Gibbs<sup>11</sup> showed that the caliber of the cerebral vessels may be altered by changes in the gaseous content of the blood, another possible mechanism by which cerebral vascular spasm might be produced. But the objection of Gowers remains unanswered: None of this evidence proves that epileptic seizures are caused by cerebral vascular spasm.

Evidence bearing directly on the problem is offered by Spielmeyer,<sup>12</sup> who reported that the lesions commonly seen in the brains of epileptic patients are such as are caused by cerebral anemia, a contention that is supported by the experimental work of Gildea and Cobb.<sup>13</sup> The most direct evidence, however, is that obtained from observation of the exposed brain during convulsions at operation. Kennedy<sup>14</sup> and Hartwell, Leriche<sup>15</sup> and Foerster and Spielmeyer<sup>16</sup> reported evidence of cerebral vasoconstriction before a convulsion. Horsley,<sup>17</sup> however, saw no such evidence, and Horrax's<sup>18</sup> observations do not suggest a preceding vascular spasm.

If a sudden cerebral vasoconstriction preceded a seizure, a sudden decrease in spinal fluid pressure should occur, and has been reported. One of us (W. G. L.) found no decrease in the spinal fluid pressure preceding petit mal attacks. A decrease in pressure does not occur regularly before a grand mal seizure. When it does occur, it may be explained by the efforts of the patient to inspire against a closed glottis.

9. Penfield, Wilder: Intracerebral Vascular Nerves, *Arch. Neurol. & Psychiat.* **27**:30 (Jan.) 1932.

10. Wolff, H. G., and Lennox, W. G.: The Effect on Pial Vessels of Variation in the Oxygen and Carbon Dioxide Content of the Blood, *Arch. Neurol. & Psychiat.* **23**:1097 (June) 1930.

11. Lennox, W. G., and Gibbs, E. L.: Blood Flow in the Leg and Brain of Man and Variations Due to Changes in the Gaseous Content of the Blood, *J. Clin. Investigation* **11**:1155, 1932.

12. Spielmeyer, W.: Die Pathogenese des epileptischen Krampfanfalles, *Histopathologischer Teil, Zentralbl. f. d. Neurol. u. Psychiat.* **44**:764, 1926.

13. Gildea, E. F., and Cobb, S.: The Effects of Cerebral Anemia on the Cortex of the Cat, *Arch. Neurol. & Psychiat.* **23**:876 (May) 1930.

14. Kennedy, F.: Epilepsy and the Convulsive State, *Arch. Neurol. & Psychiat.* **9**:567 (May) 1923.

15. Leriche, R.: Pathologic Physiology of Jacksonian Epilepsy, *Presse méd.* **28**:645, 1920.

16. Foerster, O., and Spielmeyer, W.: Die Pathogenese des epileptischen Krampfanfalles, *Deutsche Ztschr. f. Nervenhe.* **94**:15, 1926.

17. Horsley, Victor: An Address on the Origin and Seat of Epileptic Disturbance, *Brit. M. J.* **1**:693, 1892.

18. Horrax, Gill, quoted by Cobb, S., and McDonald, M. E.: Intracranial Pressure Changes During Experimental Convulsions, *J. Neurol. & Psychopath.* **4**:228, 1923.

The most detailed observations of the brain during convulsions at operation are those of Penfield.<sup>19</sup> His study is based chiefly on cases in which convulsions were produced by electric stimulation of the cortex. He concluded that the epileptic brain is subject to local vasomotor reflexes such as have never been described in the normal human brain or in the brains of animals. The vascular changes which he described occurred, however, during and after the seizures in all but one case, in which the change occurred before the seizure. To be of etiologic significance, the changes he described must precede the seizure. He observed that the one constant phenomenon visible in the brain during a seizure was the cessation of arterial pulsation. This, in some cases, appeared to be due to stopping of the heart—a rare occurrence in epileptic seizures. One wonders whether in other cases it was due to compression of a cerebral artery against the edge of the cranial opening as a result of the increase in intracranial pressure that is always present in a convulsion.

For the sake of completeness mention should be made of certain observations which have an indirect bearing on the problem, such as narrowing of the retinal arteries before a seizure (an observation which must be accepted with reserve) and pallor of the face (a by no means constant occurrence).

The therapeutic test of removal of the cervical sympathetic nerves, originally applied by Alexander, was later carried out by a number of investigators with disappointing results. Bojovitch,<sup>20</sup> Tinel,<sup>21</sup> Hirsch, Weiss, Izgur and Lauerma,<sup>22</sup> Laignel-Lavastine and Largeau,<sup>23</sup> McClintic<sup>24</sup> and others removed the periarterial sympathetic. In four cases Penfield<sup>19</sup> performed "complete sympathectomies." He attributed the lack of striking improvement to the existence of autonomic neurons which he demonstrated on the blood vessels of the brain, where they are out of surgical reach, except as they occur in highly vascularized scars.

In his book "Modern Problem in Neurology," published in 1929, Wilson<sup>25</sup> discussed at length and ended by rejecting the theory that

19. Penfield, Wilder: The Evidence for a Cerebral Vascular Mechanism in Epilepsy, *Ann. Med.* **7**:303, 1933.

20. Bojovitch, V.: Sympathectomie péri-carotidienne dans le traitement de l'épilepsie essentielle, *Rev. de chir., Paris* **63**:608, 1925.

21. Tinel, M. J.: Résultats de la sympathectomie péri-artérielle de la carotide interne dans un cas d'épilepsie essentielle, *Rev. neurol.* **31**:613, 1925.

22. Hirsch, H. L.; Weiss, M.; Izgur, L., and Lauerma, A.: Periarterial Sympathectomy in Epilepsy, *J. A. M. A.* **89**:516 (Aug. 13) 1927.

23. Laignel-Lavastine, G., and Largeau, R.: La sympathectomie péri-carotidienne (péri-carotide interne) dans l'épilepsie, *Rev. neurol.* **1**:1085, 1929.

24. McClintic, C. F.: A Surgical Treatment of Epilepsy: Epilepsy and the Convulsive State, Baltimore, Williams & Wilkins Company, 1931, p. 659.

25. Wilson, S. A. K.: Modern Problems in Neurology, New York, William Wood & Company, 1929.

epileptic seizures are caused by cerebral vascular spasm. On the other hand, Cobb,<sup>26</sup> in 1932, listed cerebral anoxemia as an important etiologic factor in epilepsy.

The problem is one that has resisted solution for more than eighty years. However, recent technical advances have made it possible to obtain crucial evidence which goes far toward settling it. Such evidence we will present in this paper. We have recorded the changes in the cerebral blood flow that precede seizures in ten patients with epilepsy, five with grand mal, and five with petit mal, seizures.

#### METHOD

Our procedure was as follows: A thermo-electric blood flow recorder was inserted through a hollow needle into the lumen of the internal jugular vein of an epileptic patient, and a continuous record made of the changes that occurred in the flow of blood while a spontaneous seizure was awaited. In twenty-four attempts we were fortunate enough to obtain records of the flow preceding and accompanying seizures in ten cases. The subjects used were patients in the neurologic unit of the Boston City Hospital and in the Monson State Hospital for Epileptics.

The flow recorder used was developed by one of us (F. A. G.)<sup>27</sup> especially for this study, and has been thoroughly tested in a series of experiments on animal and human subjects. It consists essentially of a stylet with an electrically heated tip. The stylet is inserted through a hollow needle into the lumen of the internal jugular vein. The blood stream flowing past the heated tip cools it; the faster the stream flows the cooler the tip becomes. That is, the temperature of the tip varies inversely with the rate of flow. The temperature of the tip was measured by means of thermojunctions in series with a galvanometer. In order that a change in body temperature should not be misinterpreted as a change in flow, the cold junction is mounted on the stylet behind the hot junction; it then becomes possible to measure not the absolute temperature of the tip, but the difference in temperature between the heated tip and the body of the stylet. This difference in temperature varies only slightly with changes in body temperature but greatly with changes in blood flow.

That the instrument responds with extreme sensitiveness and in the proper manner to changes in flow, when used in the internal jugular vein of human subjects, is indicated by its response in the following procedures: Light pressure on the neck over the jugular vein in which the recorder is located produces evidence of a decrease in flow within a fraction of a second (fig. 1). When the contralateral jugular vein is compressed there is evidence, within a fraction of a second, of an increase in flow. Overventilation of the lungs produces a decrease in flow (fig. 10), and breathing a 10 per cent mixture of carbon dioxide an increase (fig. 6). These observations are in accord with data secured by Lennox and E. L. Gibbs<sup>11</sup> from measurements of the gases in specimens of blood taken from an artery and from the internal jugular vein. The instrument also gives prompt indication of an increase in the cerebral blood flow due to a rise in systemic

26. Cobb, S.: Causes of Epilepsy, *Arch. Neurol. & Psychiat.* **27**:1245 (May) 1932.

27. Gibbs, F. A.: A Thermo-Electric Blood Flow Recorder in the Form of a Needle, *Proc. Soc. Exper. Biol. & Med.* **31**:141, 1933.

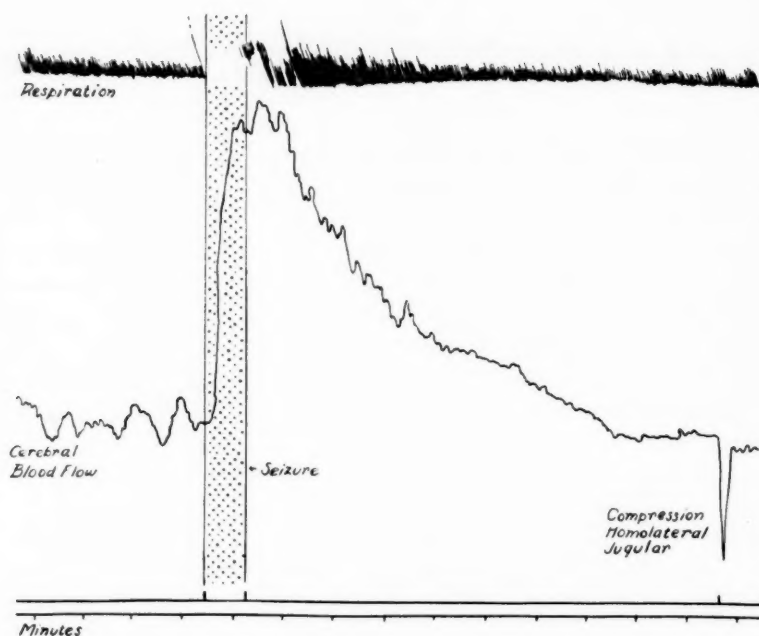


Fig. 1.—Changes in the blood flow through an internal jugular vein associated with a convulsion (patient in status epilepticus). The center tracing indicates the blood flow through the internal jugular vein; the upper tracing indicates the respiration, and the lower, time in minutes. The signal line is immediately above the time record. The stippled area indicates the duration of the seizure. The sharp dip in blood flow appearing at the right of the record was produced as a control procedure by light compression over the internal jugular vein below the point of insertion of the flow recorder.

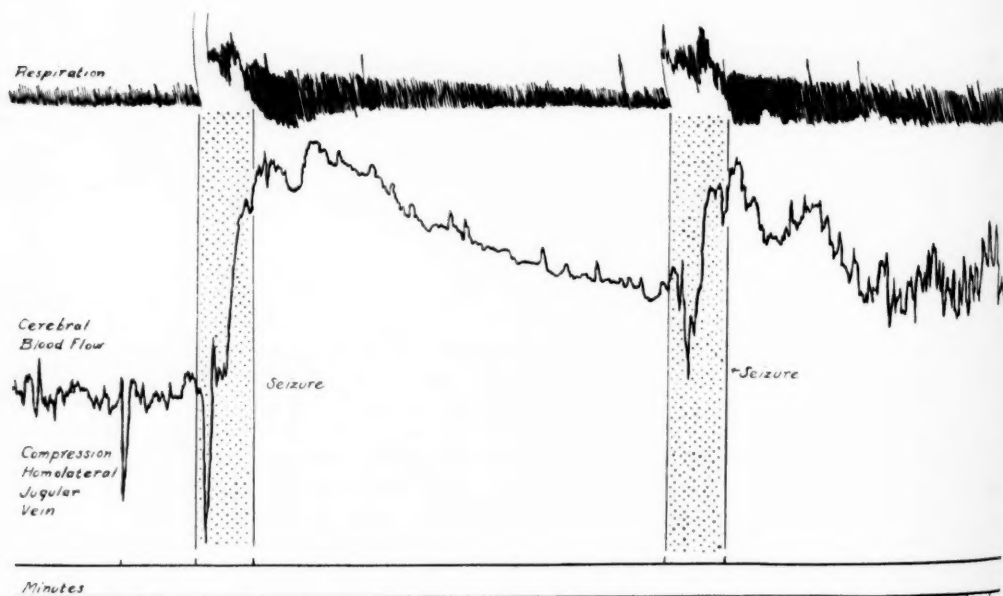


Fig. 2.—Changes in the blood flow through an internal jugular vein associated with severe generalized convulsions (patient in status epilepticus). The blood flow, respiration and time were recorded as in figure 1. The stippled areas indicate the duration of the convulsions.

arterial pressure, the flow starting up at the same time as the pressure. The decrease in blood flow which accompanied syncope associated with a sudden marked fall in the systemic blood pressure is seen in figure 11.

#### GENERALIZED CONVULSIONS

Figure 1 represents the response obtained in a patient who had a spontaneous convulsion, one of a series, occurring in status epilepticus. In this instance there were variations in the cerebral blood flow preceding the seizure. These were not, however, greater than the variations

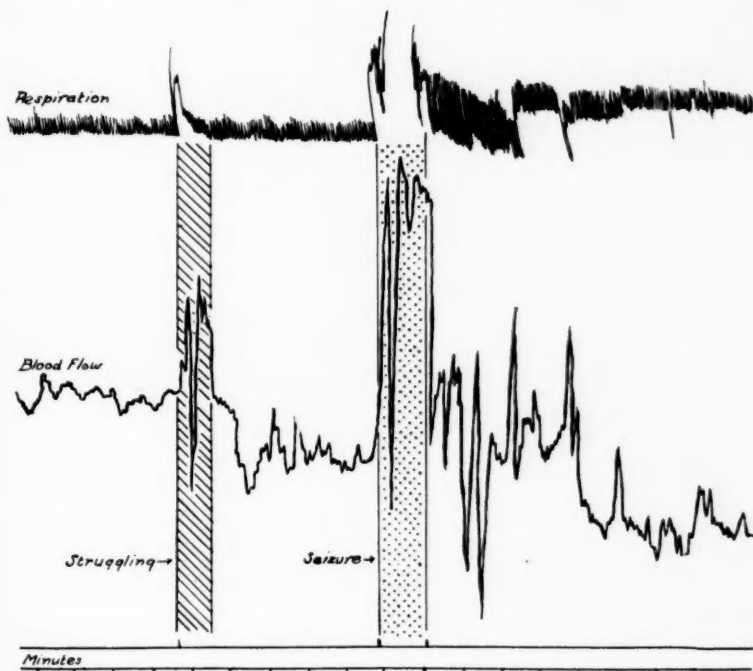


Fig. 3.—Changes in the blood flow through an internal jugular vein associated with struggling (hatched area) and with generalized convulsion (stippled area). The patient was in status epilepticus.

which occur in any restless patient. The decrease which preceded the seizure was not as marked or as enduring as decreases which occurred on numerous occasions in this patient without a convulsion supervening.

At the first tonic contraction, the lever recording respiration was thrown off the drum. A few seconds later the blood flow began to increase rapidly. It remained at a high level for approximately a minute and then, during the course of the next six minutes, gradually fell to the preconvulsion level. The sharp fall in flow at the end of the figure is a record of the control procedure of light pressure on the neck over the internal jugular vein.

The record obtained on another patient in status epilepticus having two seizures in close succession is shown in figure 2. Shortly after the beginning of the convulsion there was a sharp decrease in the cerebral blood flow. This decrease was less pronounced in the second than in the first convulsion. Because the change occurred after the

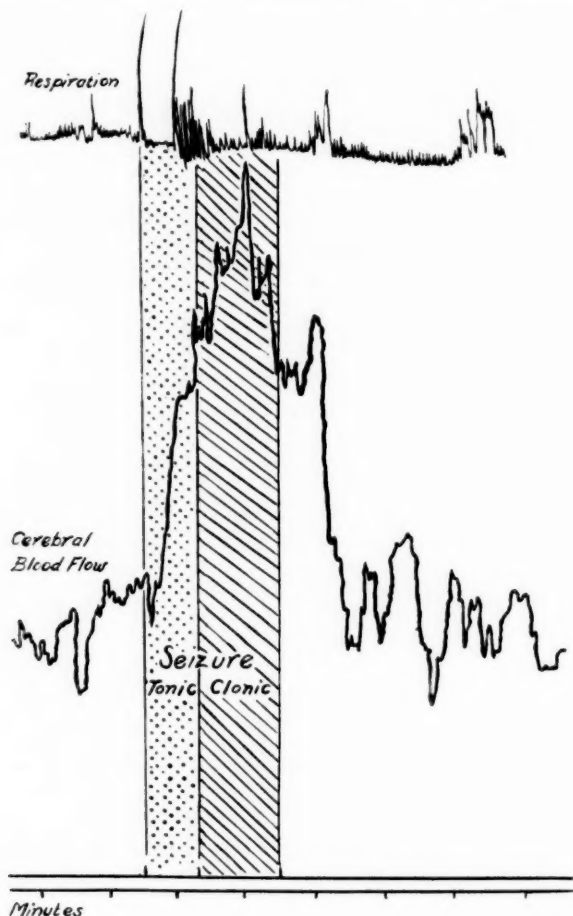


Fig. 4.—Changes in the blood flow through the internal jugular vein associated with a convulsion induced by a loud noise. The stippled area indicates the approximate duration of the tonic phase, and the barred area the duration of the clonic phase of the convulsion. The blood flow, respiration and time were recorded as in figure 1.

seizures began, it could have nothing to do with the precipitation of the attack. It was probably due to flexion of the neck and mechanical impediment to the flow through the internal jugular vein. In the ten minutes which followed the first convulsion the blood flow



had not yet returned to its previous level. After the second convulsion there were rapid fluctuations in the blood flow. The respiratory tracing shows that the patient was breathing deeply and irregularly during this period.

The record shown in figure 3 permits a comparison of muscular activity with and without a convulsive seizure. During the period of time covered by the hatched section of the record, the semicomatose patient was struggling in bed. There was, in general, an increase in the cerebral blood flow. Four minutes later a spontaneous convulsion occurred. Except for a momentary drop in the midst of the period,

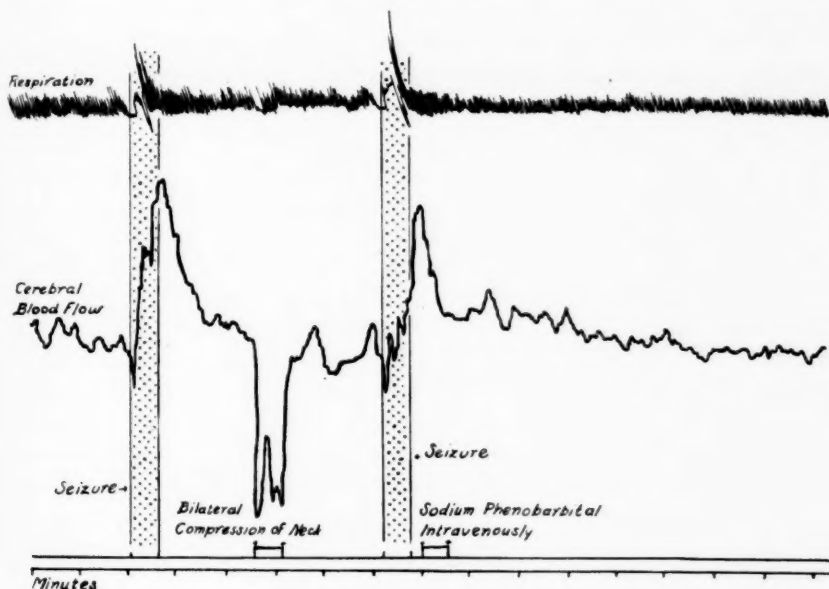


Fig. 5.—Changes in the blood flow through an internal jugular vein associated with convulsions involving the facial muscles (patient in status epilepticus). The blood flow, respiration and time were recorded as in figure 1. The stippled area indicates the duration of the convulsions. These were occurring every three or four minutes. The deep dip in the blood flow between the convulsions was produced by bilateral compression of the neck. This did not appear to hasten the appearance of the subsequent convulsion. It did not precipitate a convulsion. After the second convulsion shown on the record, sodium phenobarbital was administered intravenously and no more convulsions occurred for several hours.

there was a sustained high level of blood flow. After the convulsion subsided and while the patient was breathing heavily the flow fluctuated widely.

At the Monson State Hospital we were able to obtain records of a remarkable patient who could be thrown into a convulsion, similar in

type to the spontaneous seizures of many patients, by a loud and unexpected noise. At the drop of a pan on the cement floor the patient became apneic and rigid. The two tall peaks on the respiratory record in figure 4 were produced by movements of the body rather than by deep inspirations. It will be seen that breathing was absent or very shallow for slightly more than a minute. Hyperpnea then supervened and violent clonic movements of the extremities developed, which lasted for about a minute and then gradually subsided. The cerebral blood flow increased steadily until the violent clonic movements began to subside.

#### PETIT MAL

There are many varieties of epileptic seizures. We endeavored to secure records of types of seizures other than generalized convulsions. Records of patients with petit mal permit the separation of effects due to the muscular exertion of a violent convulsion. Presumably the behavior of the cerebral blood flow before the seizures started should be the same whether the resulting manifestations are large or small, for the violent movements of the muscles probably represent the spread of impulses from a beginning focus. The patient whose record is shown in figure 5 was in status epilepticus, and was having frequent convulsions which involved only the muscles of the face. Each of the two convulsions which appear on the record started from the normal fluctuating base-line. A slight decrease in the blood flow occurred after the onset of each seizure. The increase in the cerebral blood flow which followed did not, in the second instance, reach its peak until the visible convulsive movements had subsided. In the time between the two seizures compression was made over the internal jugular veins of the neck, a procedure which, though it produced a marked decrease in the cerebral blood flow, did not produce a seizure. After the second convulsion 3 grains (0.15 Gm.) of sodium phenobarbital was given intravenously, and no more attacks occurred for several hours. In this child, although convulsive manifestations were slight, there was virtual suspension of respiration for fifteen or twenty seconds, followed by a few seconds of deep breathing.

Another patient had, for a seizure, loss of consciousness with a mild rigidity of the muscles of the neck. In the instance in which one of these spontaneous seizures is recorded (fig. 6) we had given the patient inhalation of a mixture of 10 per cent carbon dioxide and 90 per cent oxygen a few minutes before. This produced the usual increase in the cerebral blood flow. For the three minutes preceding the seizure the patient's blood flow was fairly stable. In the midst of the tonic spasm, however, the blood flow decreased sharply. Records of other seizures in this patient showed that this was a regular occurrence. This is the

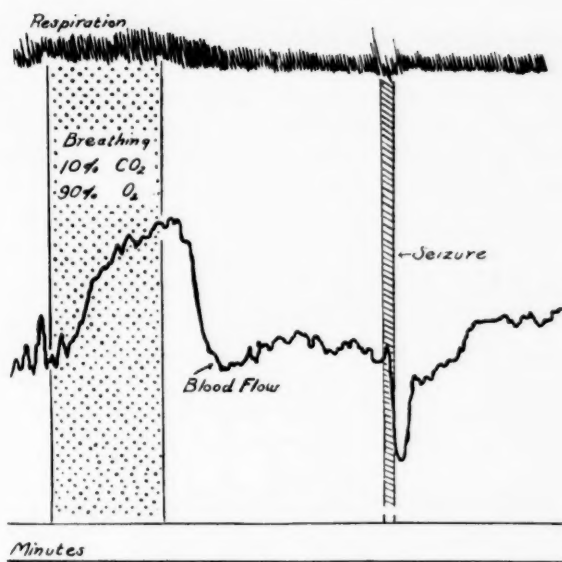


Fig. 6.—Changes in the blood flow through an internal jugular vein associated with breathing a mixture of 10 per cent carbon dioxide and 90 per cent oxygen, and associated with the occurrence of a mild tonic seizure. The stippled area indicates the duration of the administration of carbon dioxide. The barred area indicates the duration of the seizure. The blood flow, respiration and time were recorded as in figure 1.

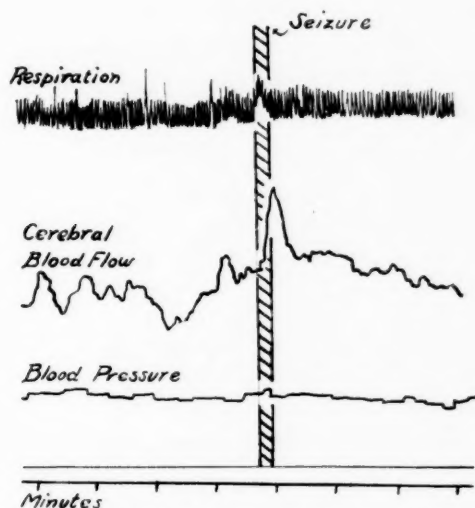


Fig. 7.—Changes in the blood flow through an internal jugular vein associated with an atypical jacksonian seizure. The barred area indicates the duration of the seizure. The blood flow, respiration and time were recorded as in figure 1. The record of the systolic blood pressure is between that of the blood flow and the time marker. The blood pressure was taken by the auscultatory method; the height of a column of mercury in a U-tube at the time the first beat was heard was transcribed by means of a lever to the moving drum. Four or five readings of pressure were made per minute.

only case in which a consistent decrease, rather than an increase, accompanied the seizure. It may have been due to compression of the jugular veins by the spasm of the muscles in the neck. The decrease in flow, however, never preceded the seizure.

Another patient had an unusual type of seizure. Consciousness was retained, but he could not speak; he became rigid, made efforts to sit up and had some shaking of the arms. These attacks occurred daily (fig. 7). Sometimes he had an aura consisting of aphasia without an attack supervening. One such episode is shown in figure 8. There was no change in the blood flow before or during this aura. The increase which followed occurred when the patient began to talk—an activity which usually produces a slight increase in the blood flow.

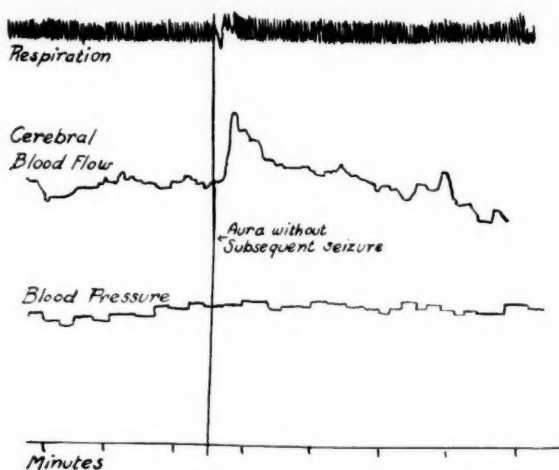


Fig. 8.—Changes in the blood flow through an internal jugular vein associated with the aura of a jacksonian seizure. The vertical line indicates the beginning of the aura. The blood flow, respiration and time were recorded as in figure 1, the blood pressure as in figure 7.

One of the patients studied had petit mal attacks (loss of consciousness with only fixity of gaze and suspension of respiration as objective signs) with great frequency. Records were obtained of scores of these minor seizures. Figure 9 shows the course of the blood flow during eleven of them. In all but one the only change in the blood flow was an increase during or at the end of the petit mal.

We were interested primarily in spontaneous seizures, but in several instances when such an attack did not occur we induced one by having the patient overventilate his lungs. One such record is seen in figure 10. For four minutes the patient was required to breathe deeply. With this procedure there was the usual sharp decline in blood flow and a

slight fall in blood pressure. Fifteen seconds after normal breathing was resumed and while the blood flow was increasing toward its previous level, one of the patient's characteristic petit mal seizures occurred, a simple loss of consciousness without visible movement. This event did

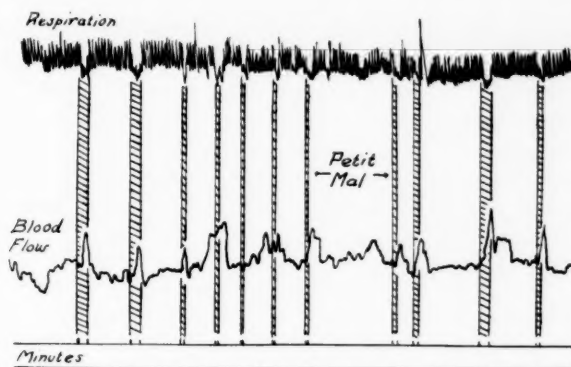


Fig. 9.—Changes in the blood flow through an internal jugular vein associated with petit mal seizures. The barred areas indicate the duration of the seizures. The blood flow, respiration and time were recorded as in figure 1.

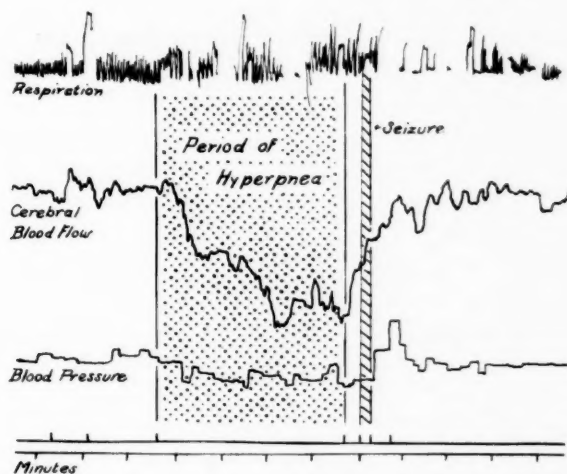


Fig. 10.—Changes in the blood flow through an internal jugular vein associated with a petit mal seizure following voluntary hyperpnea. The stippled area indicates the duration of the hyperpnea; the barred area indicates the duration of the seizure. The blood flow, respiration and time were recorded as in figure 1, the blood pressure as in figure 7.

not change the rising course of the cerebral blood flow. The seizures occurred two minutes after the lowest point in the curve of the blood flow. In this induced seizure generalized cerebral vasoconstriction and

anemia may have played a part in its production, but in our opinion the anemia was not of exclusive importance. Our full reasons for this opinion and the evidence on which it is based will form the subject of a later communication.

#### COMMENT

It is obvious from these records that a significant decrease in the cerebral blood flow does not precede a seizure. Almost without exception an increase in the blood flow accompanies the seizure. The more violent the muscular exertion the greater is the increase. Unfortunately, we were not able to obtain simultaneous records of blood pressure during generalized convulsions, because the violent muscular movements interfere with the apparatus and with accurate readings. There can be no doubt, however, that the blood pressure during apnea and a convulsion is sharply elevated. This would be sufficient explanation of the changes observed in the blood flow. There is, however, a probability that another factor plays a part. The accumulation of carbon dioxide in the blood as a result of the apnea of the tonic period would cause dilatation of the cerebral blood vessels and an increased blood flow. The hyperpnea of the postconvulsive period would act in the opposite direction, helping to restore the blood flow to its normal level. Increases during convulsions were of the same order as those which F. A. Gibbs<sup>28</sup> noted in animals in which convulsions were produced by various convulsing agents. In that work, as here, no significant decrease in the cerebral blood flow preceded the convulsions.

It might be argued that our instrument was not fast enough to give evidence of the sudden decrease in blood flow which precedes a convulsion, and that the decrease in blood flow occurring after the onset of the seizure in some of our records may really have occurred before it. Assurance may be obtained on this point from the fact that the instrument records within a fraction of a second changes in the blood flow produced by compressing either the homolateral or the contralateral jugular vein. Syncope associated with a decrease in the cerebral blood flow does not occur until after this instrument has given ample evidence of such a decrease (fig. 11).

From our observations it is certain that no widespread ischemia of the brain preceded these seizures. It might be argued that there was a chronic stasis of blood flow through the brain which may have existed for many minutes or hours before the onset of the seizure. Two of us (Lennox and E. L. Gibbs) did not find blood from the internal jugular vein more reduced in epileptic patients than in other hospital

28. Gibbs, F. A.: Cerebral Blood Flow Preceding and Accompanying Experimental Convulsions, *Arch. Neurol. & Psychiat.* **30**:1003 (Nov.) 1933.



patients. Even in patients in status epilepticus the blood leaving the brain was not unduly reduced. In two of the patients whose records are shown here, specimens of blood taken from an internal jugular vein between seizures showed an oxygen content of 12.4 and 8.99 per cent by volume, respectively. Values as low as these are often encountered in healthy, conscious persons.

There remains the possibility that the observed seizures were preceded by a spasm in a single vessel or in a small fraction of the cerebro-

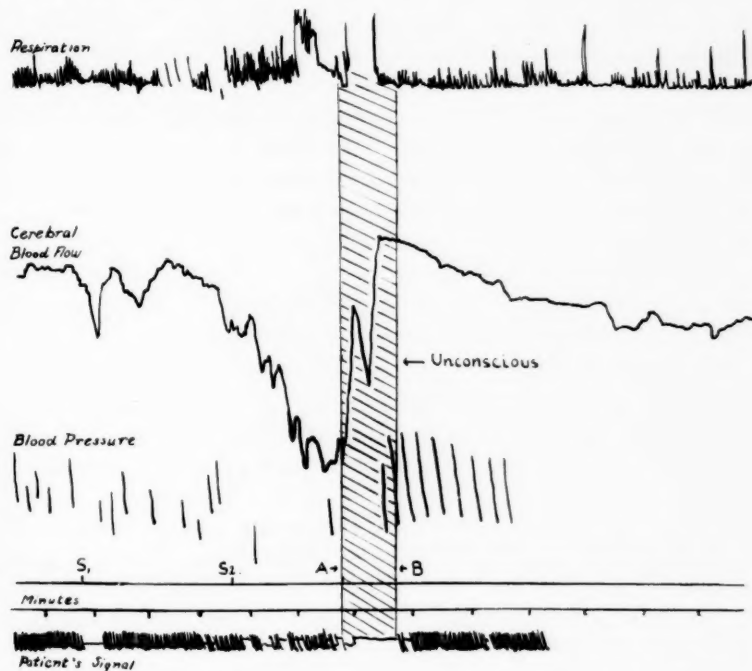


Fig. 11.—Changes in the blood flow through an internal jugular vein associated with syncope produced by forceful compression of the chest. The barred area indicates the duration of syncope. The blood flow, respiration and time were recorded as in figure 1. The record at the bottom was made by the patient who tapped a signal key. At  $S_1$  and  $S_2$ , the lower part of the patient's chest was compressed after he had taken three deep breaths and while he was holding his breath in the full inspiratory position. The slanting lines between the tracing of the blood flow and the signal line indicate blood pressure taken by the auscultatory method; the top of the line is the systolic, and the bottom the diastolic pressure. This patient was subject to epileptic convulsions. The great decrease in cerebral blood flow shown on the record, though it produced unconsciousness, did not cause a convulsion.

vascular bed. A decrease of 2 or 3 per cent of the total blood flow through the brain might have no consequences to cerebral function if

distributed over the whole brain, but if that decrease were due to an absolute cessation of flow through certain vessels a disturbance of cerebral function would probably result. This resulting dysfunction might manifest itself as an epileptic seizure. Our evidence cannot exclude the possibility that a localized cerebral angiospasm preceded the seizure. The observations of Penfield—that in the exposed brains of epileptic patients being explored by electric stimulations—there are often areas of localized pallor or ringlike and occluding constrictions of pial arteries—are in favor of such a possibility. If, however, anemia of a small area produces seizures, one would expect seizures commonly to be associated with the disease which usually produces localized anemic areas in the brain, namely, cerebral arteriosclerosis. True, the incidence of seizures is relatively high in the age group in which arteriosclerosis is common<sup>29</sup> and in persons dying of cerebral arterial disease, yet the actual incidence in these groups is so low that arteriosclerosis cannot be of decisive or exclusive importance in the genesis of seizures.

#### SUMMARY

By means of a thermo-electric blood flow recorder inserted through a hollow needle into the internal jugular vein of persons subject to epilepsy, changes in blood flow through the brain with reference to grand and petit mal seizures have been recorded.

In none of the ten patients studied was there evidence of a significant reduction in blood flow immediately preceding the onset of the seizures.

During severe convulsions there was a great increase in flow. The changes which accompanied the seizures were the result rather than the cause of the seizures.

This evidence is against the theory of acute widespread anemia of the brain as an immediate cause of epileptic seizures.

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29. Lennox, W. G.: *The Non-Institutional Epileptic: Epilepsy and the Convulsive State*, Baltimore, Williams & Wilkins Company, 1931, p. 358.

# GALVANIC SKIN REFLEX AND BLOOD PRESSURE REACTIONS IN PSYCHOTIC STATES

REACTIONS TO SENSORY, INDIFFERENT, IDEATIONAL AND CRUCIAL  
IDEATIONAL STIMULI

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In a study of reaction tendencies relating to psychopathology, patients manifesting certain psychotic mechanisms have been found to differ from normal persons and from one another in prevailing electrical skin resistance levels and in physiologic reactions to certain stimuli. Outstanding among the differences due to stimulation are those occasioned by: (1) relatively simple sensory excitations, such as sudden noises; (2) indifferent ideational stimuli consisting of words or questions, and (3) words or questions which according to the case history might be judged to have "crucial" significance for the patient. The differences have appeared sufficiently significant to justify presentation of the available data in fifty cases. Complete statistical analysis will be deferred until a second series of investigations, now in progress, is completed.

## METHODS

The test situation employed<sup>1</sup> is calculated to elicit behavior involving peripheral orientation to minor sensory stimuli, anticipation or anxiety, reaction to stimulation, recovery after reaction, summation of effects of, or adaptation to, repeated stimuli, conditioning of responses, discrimination (?) of conditioned from nonconditioned indifferent stimuli, extinction of conditioned responses, and differences in reaction to sen-

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Studies from the Behavior Research Fund and the Institute for Juvenile Research, series B, no. 194, and from the Psychiatric Institute of the Research and Educational Hospital of the University of Illinois.

1. Darrow, C. W., and Heath, L.: Reaction Tendencies Relating to Personality, in *Studies in the Dynamics of Behavior*, Chicago, University of Chicago Press, 1932, p. 59.

sory, indifferent ideational and crucial ideational stimuli. Measurement of these psychologically significant variables is in this study undertaken by photographic records of the galvanic skin reflex, continuous changes in blood pressure, and respiration.

*Blood Pressure.*—The record of blood pressure employed is of the continuous type, showing relative change, as used by Larson,<sup>2</sup> Keeler and others in the study of deception. The patient is placed in a reclining position, and the blood pressure cuff is applied to the ankle. Pressure is maintained between systolic and diastolic levels.

*Galvanic Skin Reflex.*—The galvanic skin reflex (sometimes called "psychogalvanic" reflex) when recorded with an appreciable external potential is a measure of the permeability of the skin to the passage of an electric current. It is a function of the resistance and of the polarization of the tissues, especially those of the sweat glands. We believe that the same change in permeability of the tissue which permits the secretion of sweat also permits the passing of the ions carrying the electric current, and therefore accounts for the relation between the galvanic reaction and sweat secretion.<sup>3</sup> The significance of the electrical changes recorded in this test may best appear by keeping in mind the relation to sweat secretion.

*Circuit Employed:* We were guided in the choice of an electrical circuit for measuring the galvanic skin reflex by the assumption that levels of electrical skin resistance and changes in resistance under stimulation, indicating reflex reactivity, are functionally inseparable aspects of a single phenomenon. The Behavior Research resistance box<sup>4</sup> which is employed gives continuous quantitative records in terms of standard electric units (ohms) of both the level of resistance and the magnitude of the responses to stimulation. With this circuit the current through the subject is automatically kept uniform (about 0.0409 ma.), thus eliminating an effect of the size of the current on the polarization of the skin and consequently on the apparent resistance.<sup>5</sup> The applied potential is sufficiently greater than the usual body potentials to eliminate the greater part of their distorting influence on recorded resistance.

2. Larson, J. A.: *Lying and Its Detection*, Chicago, University of Chicago Press, 1932.

3. (a) Darrow, C. W.: Sensory, Secretory, and Electrical Changes in the Skin Following Bodily Excitation, *J. Exper. Psychol.* **10**:197, 1927. (b) Richter, C. P.: Physiological Factors Involved in the Electrical Resistance of the Skin, *Am. J. Physiol.* **88**:596, 1929. (c) Darrow, C. W.: The Electrical, Circulatory, Secretory, and Thermal Reflexes of the Skin, *Proc. Internat. Cong. Psychol.* **4**:418, 1930. (d) The Relation of the Galvanic Skin Reflex Recovery Curve to Reactivity, Resistance Level and Perspiration, *J. Gen. Psychol.* **7**:261, 1932. (e) Landis, C.: Electrical Phenomena of the Skin (The Galvanic Skin Response), *Psychol. Bull.* **29**:693, 1932.

4. Darrow, C. W.: (a) Uniform Current for Continuous Standard Unit Resistance Records, *J. Gen. Psychol.* **6**:471, 1932; (b) The Behavior Research Photopolygraph, *ibid.* **7**:215, 1932.

5. (a) Wechsler, D.: The Measurement of Emotional Reactions (*Archives of Psychology*, no. 76), New York, Columbia University Press, 1925. (b) Davis, R. C.: Factors Affecting the Galvanic Reflex (*Archives of Psychology*, no. 115), New York, Columbia University Press, 1930.

Briefly, the circuit is one in which the resistances in three arms of a Wheatstone bridge are of fixed value, giving a balance when 100,000 ohms (or 300,000 ohms) resistance is introduced into the patient's arm of the bridge. Additions or subtractions of 1,000 ohm steps to or from this balance provide a scale for measuring changes in the patient's resistance. When the patient is in the circuit, sufficient standard resistance is maintained in series with his resistance to keep the galvanometer within the recording range. The patient's resistance at any time equals 100,000 ohms (or 300,000 ohms) minus the series resistance, plus or minus the scale value indicated by the deflection of the galvanometer.

**Electrodes:** A large indifferent electrode is applied to the arm or leg, the skin being pricked to eliminate the resistance. Four active electrodes of constant area ( $1\frac{1}{4}$  inches [9.18 cm.] in diameter) are attached, respectively, to the palm and the back of each hand. The electrodes are zinc plates covered with a paste of kaolin and saturated zinc sulphate. A layer of absorbent cotton soaked in physiologic solution of sodium chloride is placed between the kaolin and the skin. Special precautions are taken to keep the moisture, pressure, area and nonpolarization of the electrodes constant.

**Simultaneous Records from Palms and Backs of Hands:** By means of a commutator automatically switching first one active electrode plus a compensating standard resistance and then another active electrode plus a compensating standard into the circuit, it is possible to obtain, intermittently, records of simultaneous reaction from two or more different skin areas under identical experimental conditions without any influence of changes in one area on the records from the other. In all our later determinations, by means of switches connecting with the four active electrodes on the palms and backs of the hands, we have recorded at the beginning and at the end of a test the resistance and reactions, first of the two palms and then of the two backs. If there is an abnormal difference between the two sides of the body, suggesting unilateral pathologic changes of any kind, we take simultaneous test records from the two palms. Otherwise the two records are, respectively, from the palm and the back of the right hand. The data presented at this time are, in all cases, from the palm of the right hand.

Since the apparent resistance of the skin is attributable, in part at least, to a counter electromotive force of polarization, it might be expected that the amount of resistance recorded by this intermittent method would vary according to the rate of the intermittence and the rate at which polarization takes place in the skin. The rate of intermittence which we employ is slow, giving contacts of nearly one-half second's duration. The rate of polarization (ignoring negligible capacitative effects) varies with the condition of the skin, and as may be seen from the sample records shown in figure 1, the changes in polarization are generally completed, or about completed, within the one-half second period. In exceptional cases in which this is not true, we have followed the procedure of occasionally stopping the commutator at different points in the record to permit the polarization effects to be entirely completed and to give data on the difference between the apparent resistance as recorded by the intermittent method and that which might be obtained by the continuous method. At low apparent resistances the difference is negligible. At high apparent resistances there may be a difference of from 1,000 to 10,000 ohms. In the latter cases we present the maximum as indicated by the intermittent record.

**Test Procedure:** The test procedure<sup>1</sup> is briefly the following: Three indifferent clicks of the apparatus, at thirty second intervals, interspersed irregularly with three buzzer sounds, are presented to test peripheral sensory orientation. A

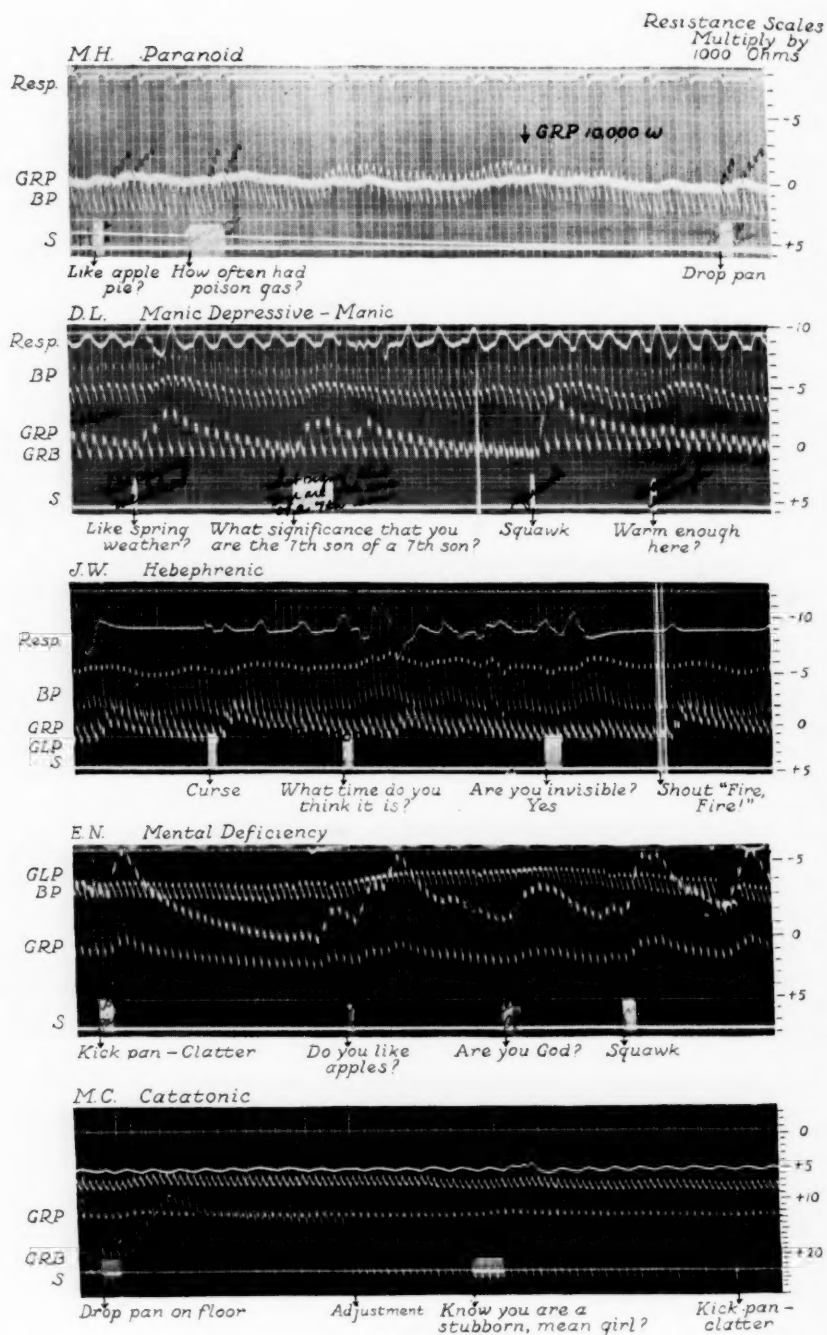


Figure 1



## EXPLANATION OF FIGURE 1

Fig. 1.—Records of reaction to varied stimuli by different patients. *Resp.* indicates respiration; *B. P.*, blood pressure; *G. R. P.*, galvanic reaction in the right palm; *G. L. P.*, galvanic reaction in the left palm; *G. R. B.*, galvanic reaction in the back of the right hand and *S*, signal marks. The vertical coordinates across the record represent second marks, and the short vertical white lines between the second marks at the top of the record, commutator marks indicating contact with the right palm.

For *M. H.* (paranoid; a single galvanic record from the palm) the resistance level is near the hypothetic minimum, at 10,000 ohms, and the galvanic deflections after stimulation are (in consequence?) relatively small, no larger than the frequent spontaneous deflections here present. Large blood pressure reactions occur after crucial ideational but not after indifferent ideational and sensory stimuli.

For *D. L.* (manic depressive-manic; galvanic records from the palm and the back of the right hand) the maximum palmar resistance on this section of the record is 21,000 ohms, and the palmar reactions occur after all stimuli save one "indifferent" question. The resistance on the back remains near 101,000 ohms, and there is only slight evidence of reaction to stimulation. Polarization effects on the back are about completed during the one-half second of contact. There is little evidence of slow polarization on the palm. A marked rise in blood pressure occurs after all stimuli.

For *J. W.* (hebephrenic; galvanic records from the right and left palms with close parallelism of reactions from the two sides) the maximum resistances in this section of the record are about 31,000 ohms, and the record shows that polarization is not quite completed within the one-half second of contact. In the early portion of this record during the series of automobile horn stimuli the resistance of the left palm (about 40,000 ohms) was definitely higher than that of the right, which was at the 31,000 ohm level, and showed reactions paralleling those on the right. Less galvanic reaction occurs after the crucial stimulus, "Are you invisible?" than after other stimuli. Blood pressure reactions appear indiscriminately large after all ideational stimuli.

For *E. N.* (mental deficiency; galvanic records from the right and left palms) a markedly higher resistance is shown by the left palm than by the right. A much greater reaction is evident on the left. Effects of slow polarization during the one-half second of contact are more evident on the right. A prolonged rise in blood pressure and a series of galvanic reactions occur after the question, "Do you like apples?" A crucial question, "Are you God?" produced considerably smaller blood pressure and galvanic reactions.

For *M. C.* (catatonic; galvanic records from the right palm and right back) very slight galvanic reactions are evident in the right palm at around 22,000 ohms. The back shows a large drop in resistance (from 80,300 to 70,300 ohms) after the clatter of dropping an enamelware pan on the floor. Polarization of the back is far from completed in the one-half second of contact. The blood pressure shows only slight effects from the various stimuli.

verbal warning of the impending stimuli is given, followed by two minutes of anticipation. Next are seven automobile horn stimuli, immediately preceded in each case by the click of the apparatus. Following the clicks combined with the horn sounds, three clicks, irregularly interspersed with three buzzer sounds, are presented to test the conditioning or association of the click with the horn sound. The reaction to the buzzers gives indication of the degree of spread or non-specificity of the conditioning, what Slight<sup>6</sup> termed the "generalization of the affect." Then the patient is warned that he will be asked questions. A series of sensory stimuli and indifferent ideational and crucial ideational questions is presented in mixed order. An analysis of the results from this portion of the test will occupy the greater part of this presentation. Excerpts from the photographic records are presented in figure 1. We also give data on the reactions to the first three of the series of automobile horn stimuli.

*Criteria of the Psychiatric and Psychologic Status of the Patient.*—As criteria of the psychiatric, psychologic and physiologic condition of the patient, we employ (1) data from the case histories (supplemented by first-hand knowledge of one of us [S.] of the behavior of the patient in the ward) and (2) ratings by one of us (S.) on the condition and behavior of the patient at the time of the test.

*Treatment of Data.*—The physiologic measures and clinical data for each patient have been transferred to tracing cloth in large tables, and the material has been arranged and blueprints of it made; it has been studied by a method described elsewhere.<sup>7</sup>

#### RESULTS

From among the interrelationships revealed by the blue-printed tables, five have been selected for presentation in this paper: (A) the relation between physiologic subnormality and subnormal reactivity to stimulation; (B) the relation between subnormal reactivity and poor insight, poor attention and withdrawal; (C) the relation between a large rise in blood pressure and a small galvanic effect after ideational stimuli and the apparent exaggeration of the patient's "defense" or "projection" mechanisms; (D) the relation between our measures of reaction and the clinical diagnosis, and (E) the relation between the resistance level and what we shall term the patient's "free energy or anxiety."

*A. Relation Between Physiologic Subnormality and Subnormal Reactivity to Stimulation.*—To show the relationship between these two conditions we present the ratings on the "nutrition" of the patients (whether they were well or ill nourished) in combination with data on the magnitude of reaction to various types of stimuli. In each histogram in figure 2, the ratings for patients giving small or minimum reactions are shown in the top row, and those for the patients with maximum reactions, in the bottom row. The ratings for patients giving reactions of intermediate magnitude are presented in the intermediate fifths of the chart. The number 1 indicates well nourished; 3 represents ill nourished, and 2 indicates

6. Slight, D.: The Conditioned Psychogalvanic Response, in Contributions to Psychiatry, Neurology and Sociology, dedicated to the late Sir Frederick Mott, New York, Paul B. Hoeber, Inc., 1929, p. 361.

7. Darrow, C. W.: A Photographic Technic for the Study of Extensive Data on Small Populations, Science **78**:61, 1933.

moderately nourished. The histograms in figures 2 and 3 show a general tendency for more poorly nourished patients to have smaller blood pressure and "per cent"<sup>8</sup> galvanic reactions. The relationship is least marked after the mixed sensory stimuli.

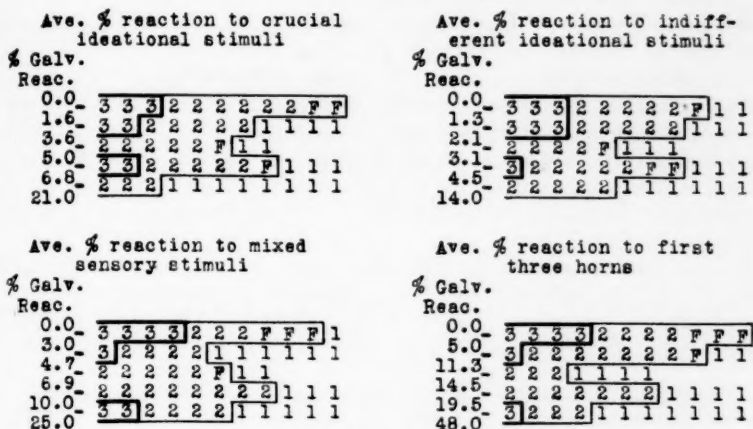


Fig. 2.—Histograms showing the relation of the state of nutrition to per cent galvanic reaction. In this and the following figures 1 indicates well nourished; 3, ill nourished; F, obese. There is a tendency for more poorly nourished persons to give smaller per cent galvanic reactions.

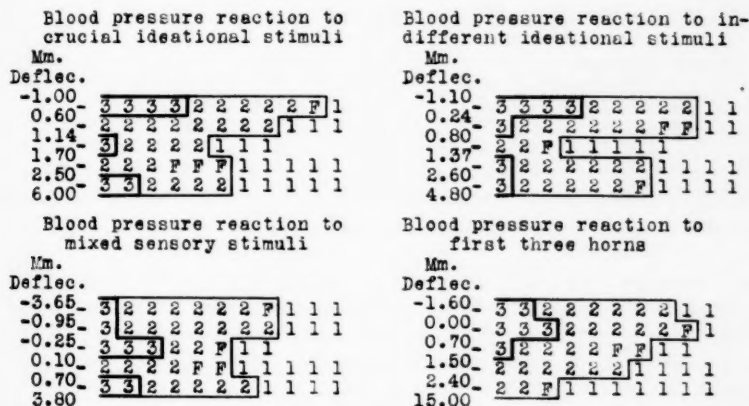


Fig. 3.—Histograms showing the relation of the state of nutrition to blood pressure deflections. There is a tendency for more poorly nourished persons to give smaller blood pressure reactions after the ideational and automobile horn stimuli.

The reason for using per cent galvanic reaction, or  $\frac{\text{reaction in ohms} \times 100}{\text{resistance in ohms before reaction}}$ , is that this procedure appears necessary to render comparable the reactions of persons at different resistance levels. Within moderate ranges of resistance, with the

8. "Per cent" is used as an adjective in contrast with "absolute."

current through the skin kept constant, a large absolute change in resistance, say 10,000 ohms, in a person with resistance of 50,000 ohms, will be associated with about the same amount of disturbance, as indicated by other psychologic and physiologic criteria, such as the reflex start, change in blood pressure, perceptible change in muscle tension, verbal exclamations, etc., as a change in resistance of 1,000 ohms in a person at the 5,000 ohm level. It is not assumed that the use of percentages of resistance level offers a complete correction, especially at the extremes of high and low resistance. A special significance which may attach to an absolute change in resistance, particularly at high levels, will be considered in the comment in section E. A recent study indicates that the amount of perspiration secreted per second tends to vary as the reciprocal of resistance in a corresponding area, or as *conductance*. According to this evidence, the use of percentages does not completely compensate for the curvilinear relation of resistance to physiologic activity.

In order that the data on reactivity here shown will not be attributed to the effects of a high resistance level on the magnitude of our percentages, we offer in figure 4 data on nutrition in relation to resistance level<sup>9</sup> and also in relation to absolute change in resistance after crucial stimuli. It is seen that absolute change

| Absolute galvanic reaction<br>to crucial ideational stimuli |   |   |   |   |   |   |   |   |   |   |   |   | Minimum resistance level<br>during series of horn stimuli |   |   |   |   |   |   |   |   |   |   |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|
| Ohms<br>Reac.   |   |   |   |   |   |   |   |   |   |   |   |   | Ohms<br>Resist.   |   |   |   |   |   |   |   |   |   |   |  |  |
| 00  | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | F | 1 | 1 | 110,000   | 3 | 2 | 2 | 2 | 2 | 2 | 2 | F | F | 1 |  |  |
| 300   | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | F | 1 | 1 | 35,000  | 3 | 3 | 3 | 2 | 2 | 2 | F | F | 1 | 1 |  |  |
| 670   | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | F | 1 | 1 | 22,400  | 3 | 3 | 2 | 2 | 2 | 2 | F | F | 1 | 1 |  |  |
| 920   | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | F | 1 | 1 | 16,000  | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |  |  |
| 1580  | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | F | 1 | 1 | 11,100  | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |  |  |
| 3360  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | F | 1 | 1 | 7,000   | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |  |  |

Fig. 4.—Histograms showing the relation of the state of nutrition to absolute (ohms) change in resistance and to the resistance level. There are smaller absolute (ohms) galvanic reactions in patients with poorer nutrition, but there appears to be little relation between poor nutrition and the resistance level.

in resistance also relates to poor nutrition, although not to quite the same degree as per cent change. There is little evidence of a relation to the resistance level.

Ratings on other matters relating to health show similar relationships to those observed for nutrition, and there is a tendency, subject to wide variability, for patients having small reactions to show lower systolic and diastolic blood pressures, lower hemoglobin contents, lower color indexes, higher pulse rates, higher blood cholesterol, higher white cell counts and greater numbers of lymphocytes.

The failure of poor nutrition to appear related to the magnitude of the blood pressure reactions after mixed sensory stimuli may possibly be accounted for. It will be noted that the mixed sensory stimuli produced large minus deflections in blood pressure about as often as large plus reactions in the patients having good nutrition, and that the zero reactions, generally by patients having poor nutrition, tend to fall in the middle of the histogram. It seems likely that a minus blood pressure reaction is not, from the standpoint of physical health, less than a zero reaction but is, in a sense, a truly positive physiologic effect.

9. The resistance level here used is the minimum resistance reached during the series of auto horn stimuli. This measure is used rather than "initial" resistance because we have complete data on it and it is nearer to the value prevailing during the series of mixed sensory and ideational stimuli than is initial resistance.

*B. Reaction to Stimulation in Relation to Insight, Attention and Withdrawal.*—Concomitant with a subnormal physiologic condition and a slight reaction to stimulation, we find evidence of certain defective mental functions involving the orientation of the patient to his world. Outstanding are the psychiatrist's notations regarding the patient's "insight" and "capacity for attention." In figure 5, patients who were referred to as having markedly poor insight or attention are rated 3,

| % Galv.<br>Reac.         | Insight                    |   |   |   |   |   |   |   |   |   | Attention                      |   |   |   |   |   |   |   |   |   |
|--------------------------|----------------------------|---|---|---|---|---|---|---|---|---|--------------------------------|---|---|---|---|---|---|---|---|---|
|                          | Crucial Ideational Stimuli |   |   |   |   |   |   |   |   |   | Indifferent Ideational Stimuli |   |   |   |   |   |   |   |   |   |
| 0.0                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 1.6                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3.6                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5.0                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 6.8                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 21.0                     | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Mixed Sensory Stimuli    |                            |   |   |   |   |   |   |   |   |   |                                |   |   |   |   |   |   |   |   |   |
| 0.0                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3.0                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4.7                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 6.9                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 10.0                     | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 25.0                     | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| First Three Horns        |                            |   |   |   |   |   |   |   |   |   |                                |   |   |   |   |   |   |   |   |   |
| 0.0                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5.0                      | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 11.3                     | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 14.5                     | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 19.5                     | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 48.0                     | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Minimum Resistance Level |                            |   |   |   |   |   |   |   |   |   |                                |   |   |   |   |   |   |   |   |   |
| 110,000                  | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 35,000                   | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 22,400                   | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 16,000                   | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 11,100                   | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 7,000                    | 3                          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

Fig. 5.—Histograms showing the relation of insight and attention to per cent galvanic reaction to ideational and sensory stimuli. In this and the following figures, 1 indicates good insight or attention and 3, poor insight or attention. There is a tendency for patients having poor insight and attention to give small per cent galvanic reactions to sensory and ideational stimuli and to have a higher resistance.

while those who were moderately inferior are graded 2 and those with good insight and capacity for attention, 1.

To show that the relation between the per cent galvanic reaction and the resistance level is not a function of the resistance level due to our use of the per cent galvanic reaction as a measure of physiologic excitation, we include in

figure 6 similar data on the absolute (ohms) reaction. These merely confirm what may be observed in the corrected (percentage) data.

In figure 7 the patients' average blood pressure reactions to crucial ideational and other stimuli have been ranked and divided into fifths, as were the galvanic

| Ohms<br>Reac. | Insight               | Attention             |
|---------------|-----------------------|-----------------------|
| 00-           | 3 3 3 3 3 3 3 3 2 2 2 | 3 3 3 3 3 2 1 1 1 1 1 |
| 300-          | 3 3 3 3 3 3 3 2 2 1 1 | 3 2 2 1 1 1 1 1 1 1 1 |
| 670-          | 3 3 3 3 3 2 2 1       | 3 2 2 1 1 1 1 -       |
| 920-          | 3 3 3 2 2 2 2 2 1 1 ? | 2 2 2 1 1 1 1 1 1 1 1 |
| 1580-         | 3 3 3 3 2 2 2 2 2 1 - | 3 3 2 2 2 1 1 1 1 1 1 |
| 3360-         |                       |                       |

Fig. 6.—Histograms showing absolute reactions in ohms to crucial ideational stimuli. These data confirm the relationships observed in the corrected (percentage) data.

| Mm. B. P.<br>Deflec.           | Insight               | Attention             |
|--------------------------------|-----------------------|-----------------------|
| Crucial Ideational Stimuli     |                       |                       |
| -1.00-                         | 3 3 3 3 3 3 3 2 2 1   | 3 3 3 3 2 2 1 1 1 1 - |
| 0.60-                          | 3 3 3 3 3 2 2 2 1 1   | 3 3 3 2 2 1 1 1 1 1 1 |
| 1.14-                          | 3 3 3 3 3 3 2 2       | 3 2 1 1 1 1 1 1       |
| 1.70-                          | 3 3 3 3 3 2 2 2 1 1 ? | 3 2 2 1 1 1 1 1 1 1   |
| 2.50-                          | 3 3 3 2 2 2 2 2 2 1 - | 2 2 2 2 1 1 1 1 1 1   |
| 6.00                           |                       |                       |
| Indifferent Ideational Stimuli |                       |                       |
| -1.10-                         | 3 3 3 3 3 3 2 2 2 1 1 | 3 2 2 1 1 1 1 1 1 1 - |
| 0.24-                          | 3 3 3 3 3 3 3 2 2     | 3 3 3 1 1 1 1 1 1 1   |
| 0.80-                          | 3 3 3 3 3 2 2 1       | 3 2 1 1 1 1 1 1       |
| 1.37-                          | 3 3 3 2 2 2 2 2 2 1 1 | 3 3 2 2 2 2 1 1 1 1   |
| 2.60-                          | 3 3 3 3 2 2 2 2 1 ? - | 3 3 2 2 2 2 1 1 1 1   |
| 4.80                           |                       |                       |
| Mixed Sensory Stimuli          |                       |                       |
| -3.65-                         | 3 3 3 3 2 2 2 2 1 1 1 | 3 2 2 2 1 1 1 1 1 1   |
| -0.95-                         | 3 3 3 3 3 3 2 2 1 -   | 3 2 2 1 1 1 1 1 1 -   |
| -0.25-                         | 3 3 3 3 3 2 2 1       | 3 3 2 1 1 1 1 1       |
| 0.10-                          | 3 3 3 3 3 3 3 2 2 2   | 3 3 3 2 2 2 1 1 1 1   |
| 0.70-                          | 3 3 3 2 2 2 2 2 2 1 ? | 3 3 2 2 1 1 1 1 1 1   |
| 3.80                           |                       |                       |
| First Three Horns              |                       |                       |
| -1.60-                         | 3 3 3 3 3 2 2 2 1 1   | 3 2 2 2 2 1 1 1 1 1   |
| 0.00-                          | 3 3 3 3 3 2 2 2 2 1   | 3 3 1 1 1 1 1 1 1 -   |
| 0.70-                          | 3 3 3 3 3 3 3 3       | 3 3 3 3 3 2 1 1 1     |
| 1.50-                          | 3 3 2 2 2 2 1 1 1 -   | 3 2 1 1 1 1 1 1 1     |
| 2.40-                          | 3 3 3 3 2 2 2 2 2 ?   | 3 2 2 2 1 1 1 1 1 1   |
| 15.00                          |                       |                       |

Fig. 7.—Histograms showing the relation of insight and attention to blood pressure reactions to ideational and sensory stimuli. There is a tendency for persons with poor insight and attention to give smaller blood pressure reactions to crucial ideational stimuli. Poor insight and attention show little relationship to the blood pressure reactions after sensory stimuli.

reactions in the preceding histograms. It will be seen that poor insight and poor attention are associated with low blood pressure reactions to crucial ideational stimuli. With other stimuli no such tendency is apparent. The specificity of a rise



in blood pressure for crucial ("disturbing") ideational stimuli here evident is in conformity with previous observations on normal persons.<sup>10</sup>

| Inaccessibility<br>Withdrawal<br>Catatonia |                            | Sociability (Absence<br>of Withdrawal<br>Tendencies) |           |
|--|----------------------------|--|-----------|
| % Galv.<br>Reac.                           | Crucial Ideational Stimuli |  |           |
| 0.0  | IcIcI I I I W W - -        | 3 3 3 3 3 3 3  | 2 2 1 1   |
| 1.6  | I I W W - - - - -          | 3 3 3 3 3 3 3  | 2 2 1 1   |
| 3.6  | I W W W W - - - -          | 3 3 3 3 2 1 ?  | -         |
| 5.0  | IcI W W - - - - -          | 3 3 3 3 3 2  | 2 2 1 1 1 |
| 6.8  | - - - - -                  | 3 3 3 2 2 2 1  | 1 1 1 1   |
| 21.0                                       | - - - - -                  | - - - - -  | - - - - - |
|  |                            | Indifferent Ideational Stimuli                       |           |
| 0.0  | IcIcIcI I I W W - -        | 3 3 3 3 3 3 3  | 2 1 1 1   |
| 1.3  | I I I I W W - - - -        | 3 3 3 3 3 3 2  | 2 1 1 -   |
| 2.1  | W - - - -                  | 3 3 3 2 1 1 1  | 1         |
| 3.1  | W W W - - - - -            | 3 3 3 3 3 3 3  | 2 2 1 1   |
| 4.5  | I I I W W - - - - -        | 3 3 3 2 2 2 2  | 2 1 1 ?   |
| 14.0                                       | - - - - -                  | - - - - -  | - - - - - |
|  |                            | Mixed Sensory Stimuli                                |           |
| 0.0  | IcIcIcI W W - - - -        | 3 3 3 3 3 3 3  | 1 1 1 1   |
| 3.0  | I I W - - - - -            | 3 3 3 2 2 2 1  | 1 1 1 ?   |
| 4.7  | I I W W - - - - -          | 3 3 3 2 2 2 1  | 1         |
| 6.9  | I I I W W W - - - -        | 3 3 3 3 3 3 3  | 2 2 2 1   |
| 10.0                                       | I W W - - - - -            | 3 3 3 3 3 3 2  | 2 2 1 1 - |
| 25.0                                       | - - - - -                  | - - - - -  | - - - - - |
|  |                            | First Three Horns                                    |           |
| 0.0  | IcIcIcI W W - - - -        | 3 3 3 3 3 3 3  | 2 2 1 1 1 |
| 5.0  | I I I W W - - - - -        | 3 3 3 3 3 3 3  | 2 2 1 1 - |
| 11.3                                       | I I W - - - - -            | 3 2 2 1 1 1 ?  | -         |
| 14.5                                       | I I W W W - - - - -        | 3 3 3 3 3 3 3  | 2 2 1 1 1 |
| 19.5                                       | I I W W - - - - -          | 3 3 3 3 3 3 3  | 2 2 1 1 1 |
| 48.0                                       | - - - - -                  | - - - - -  | - - - - - |
| Ohms<br>Resist.                            |                            | Minimum Resistance Level<br>During Horn Stimuli      |           |
| 110,000                                    | IcI I W W W W - - - -      | 3 3 3 3 3 3 3  | 2 2 1 -   |
| 35,000                                     | IcIcI W W W W - - - -      | 3 3 3 3 3 3 2  | 1 1 1 ?   |
| 22,400                                     | I I I I W - - - - -        | 3 3 3 3 3 3 2  | 1         |
| 16,000                                     | I I W - - - - -            | 3 3 3 2 2 2 2  | 1 1 1 1   |
| 11,100                                     | W - - - - -                | 3 3 3 3 2 2 2  | 1 1 1 1   |
| 7,000                                      | - - - - -                  | - - - - -  | - - - - - |

Fig. 8.—Histograms showing the relation of inaccessibility and withdrawal tendencies to per cent galvanic reaction to ideational and sensory stimuli. In this and the following figures inaccessibility is indicated by *I*, withdrawal by *W* and catatonia by *c*. The different degrees of sociability (absence of withdrawal tendencies?) are indicated by 1, high, and 3, low. There is a tendency for more withdrawn, inaccessible and unsociable persons to give smaller per cent galvanic reactions to ideational stimuli and to have higher resistance levels. This difference is not marked in the case of reactions after sensory stimuli.

10. Darrow, C. W.: (a) Electrical and Circulatory Responses to Brief Sensory and Ideational Stimuli, *J. Exper. Psychol.* **12**:267, 1929; (b) Differences in the Physiological Reactions to Sensory and Ideational Stimuli, *Psychol. Bull.* **26**:185, 1929.

Similar treatment was given to case history notations on "inaccessibility" (*I*) and "withdrawal tendencies" (*W*). When both inaccessibility and withdrawal are mentioned in a case, inaccessibility (*I*) alone has been indicated. The small letter (*c*) following the letter (*I*) indicates catatonia. Other data which we have interpreted as having significance for the observations on withdrawal are statements relative to the "sociability" manifested by the patients in the ward. These data are also presented, the number 1 indicating marked inclination toward social participation, and 3, absence of the tendency. These data are, in a sense, complementary to the data on withdrawal tendencies. It will be seen from figures 8, 9 and 10 that both galvanic and blood pressure reactions to crucial ideational stimuli tend to be small in the more inaccessible or withdrawn patients, while this tendency is either absent or much less marked with other stimuli. In detailed study of individual patients showing withdrawal we have frequently noted a selective low galvanic reaction to all crucial ideational stimuli, or to some and not to others, in the presence of moderate to large galvanic reactions to indifferent and sensory stimuli.

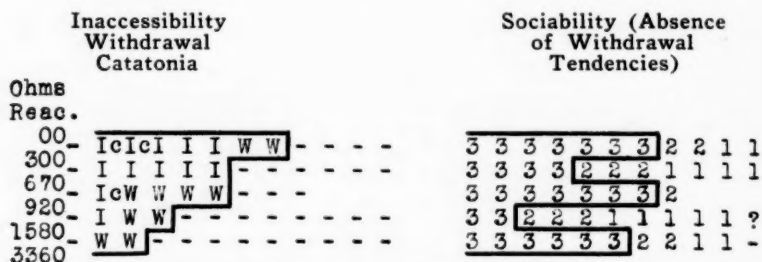


Fig. 9.—Histograms showing absolute reaction in ohms to crucial ideational stimuli. That the relationship to withdrawal and inaccessibility is not a function primarily of resistance level and attributable to "correction" by the use of percentages is shown by the fact that a similar tendency is found in the relation to absolute (ohms) reaction. This appears definitely less true of sociability.

Other observations in the case histories showing relationships to the physiologic measures similar to poor insight, poor attention and "withdrawal" are: mannerisms, negativism, antagonism, ill-naturedness, inability to adjust to general life situations, sense of inferiority, visual hallucinations (?) and compulsions.

*C. Relation Between a Large Rise in Blood Pressure and a Small Galvanic Effect After Ideational Stimuli and the Apparent Exaggeration of the Patient's "Defense" or "Projection" Mechanisms.*—It is striking that while the greater part of the clinically reported pathologic behavior is associated with both small galvanic and small blood pressure reactions to crucial ideas, there is one group of manifestations which tend to be related to small galvanic and large blood pressure changes. The histograms in figure 11 show, in the case of the galvanic effects after ideational stimuli, a grouping of higher ratings on irritability, toward the end of the distribution showing the smaller reactions, and in the case of blood pressure, toward the end for the larger reactions. The reactions to sensory stimuli do not show this difference in distribution and have been omitted. Other clinical ratings definitely showing this tendency are "aggressiveness," "violent

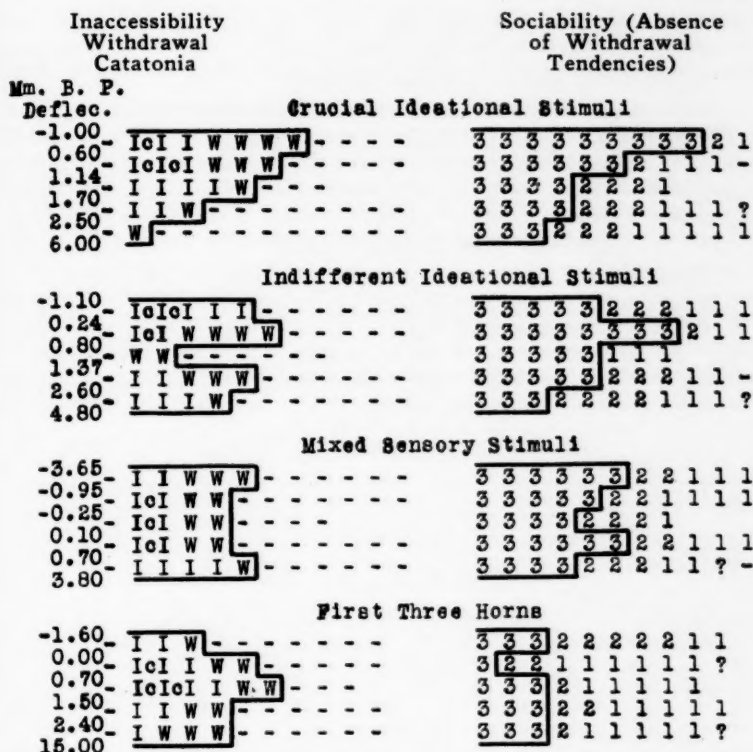


Fig. 10.—Histograms showing the relation of inaccessibility and withdrawal tendencies to blood pressure reactions to ideational and sensory stimuli. There is a tendency for inaccessible, withdrawn and unsociable persons to give smaller blood pressure reactions after crucial ideational but not after other stimuli.

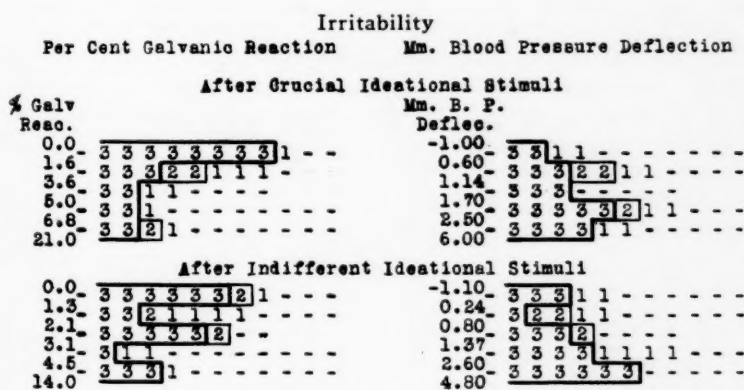


Fig. 11.—Histograms showing the relation of irritability to galvanic and blood pressure reactions to ideational stimuli. 1 indicates absence of irritability; 3, marked irritability. There is a tendency for the more irritable persons to give smaller galvanic and larger blood pressure reactions after these stimuli.

temper tantrums" and "changeability of mood." In the histograms showing diagnostic groupings in relation to blood pressure (fig. 11), a tendency for paranoid patients to show a large rise in blood pressure after crucial stimuli will be noted.

*D. Relation of Reactions to the Individual Traits and Diagnostic Grouping of the Patients.*—We are aware that the clinical classification of a given psychosis implies that certain mental mechanisms are present, with one or more of these predominating during a more or less characteristic clinical course. It is obvious that our test procedure relates only to the condition of the patient at the time of the test. Since psychotic behavior at a given time varies with the nature of the mechanism which happens to be predominant, we should expect that our data would show more relation to the predominant mechanism than to the clinical classification of the condition. It is possible that in a study of a large number of patients with clinically similar cases, when the number in each group is not reduced by subdivision, there would be a sufficient number of patients showing certain of the mechanisms predominant at the time of the test to give a correlation between clinical classification and such data as we present. It is apparent from our data that the various measurements of physiologic reaction in any patient may acquire their chief psychiatric significance from their relation to the stimulating condition employed. Landis<sup>11</sup> summarized data on the galvanic skin reflex reported by different investigators and showed that when there is no consideration of the type of stimulus or of the method of recording or treating the data there are few significant consistencies.

In figures 12 and 13 the patients represented in the respective fifths of our data for each of the measures have been subdivided according to a clinical diagnosis made by Dr. H. Douglas Singer after consideration of each patient by the hospital staff. The capital letters in each column stand for the classification, and the small succeeding letters, when present, indicate either (1) that there was considerable evidence favoring the alternative diagnosis suggested by the letter or (2) that the earlier history of the patient, if solely relied on, would have favored the alternative classification.

*The Diagnostic Groups in Relation to the Galvanic Reactions.*—Catatonic Group: In the column marked "catatonic" (C) in figure 12 there is a tendency (with the exception of Cp) toward very slight galvanic reactions to sensory stimuli. This tendency is appreciably less marked after ideational items. The patients classified as having catatonia did not constitute a clinically homogeneous group. Although the patients were withdrawn and negativistic and showed moderate to severe stereotyped movements, attitudes and mannerisms, only two showed catalepsy, one whose condition was classified as Cp, in a high degree, and the other only moderately.

The patient whose condition was classified as Cp, with the largest galvanic and blood pressure reactions, showed marked hyperkinesia and catalepsy. Peculiar bodily attitudes were usually present only when attention was drawn to him. Experimental study with sodium amytal during a retest revealed that he was in contact with the outside world even to the extent of remembering the names of two persons to whom he had been introduced only once during a mute period. When visited by his family, prolonged crying, associated with no other cataleptic change, was observed. During periods of automatic obedience he exhibited laughter when

11. Landis, C.: Psychiatry and the "Psychogalvanic Reflex," *Psychiat. Quart.* 6:262, 1932.

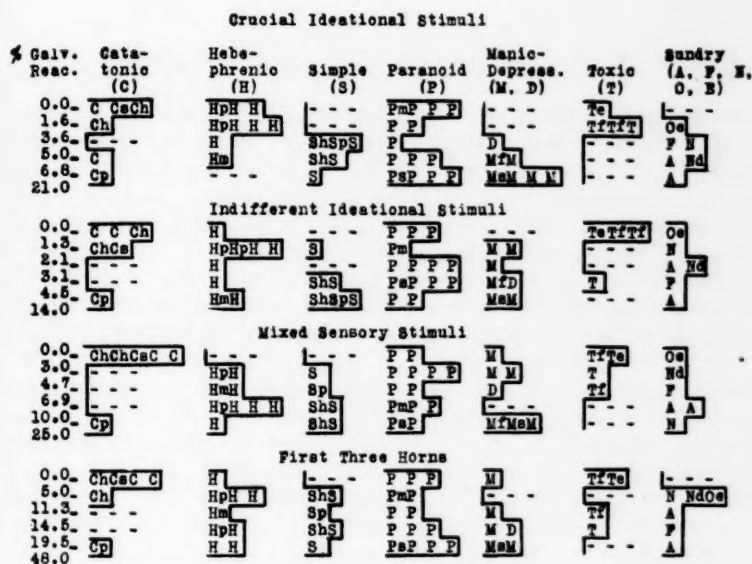


Fig. 12.—Histograms showing the relation of the clinical diagnosis to per cent galvanic reaction to ideational and sensory stimuli. The least effects from sensory stimuli are shown by patients in catatonic stupor; the least effects from crucial ideational stimuli by hebephrenic patients; the least effects from ideational stimuli, by toxic patients; the greatest effects from crucial ideational stimuli, by manic patients, and generally large effects from all stimuli, by patients with simple schizophrenia. A indicates arteriosclerosis; F, mental deficiency; N, compulsion neurosis; O, organic psychosis; E, postencephalitis; Nd, psychoneurotic depression.

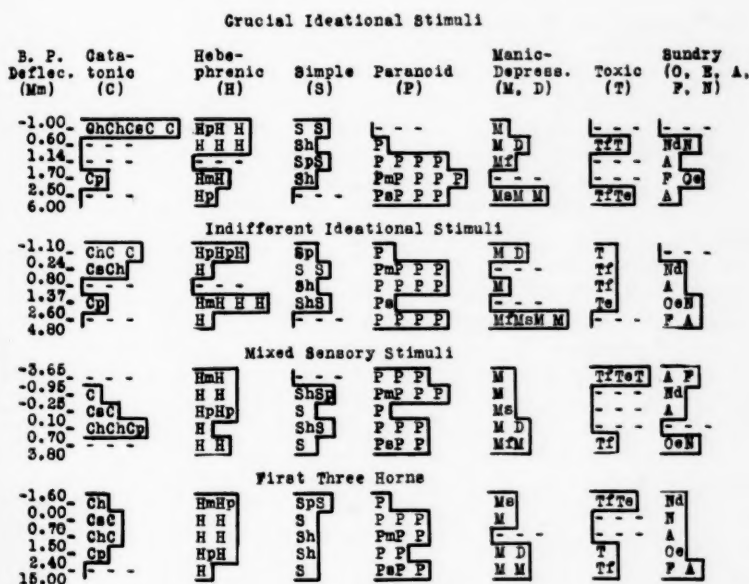


Fig. 13.—Histograms showing the relation of the clinical diagnosis to blood pressure reactions to ideational and sensory stimuli. O indicates organic psychosis; E, postencephalitis; A, arteriosclerosis; F, mental deficiency; N, psychoneurosis.



the stimulus was strong enough, as when he was told to look in the mirror at his face covered with mashed potatoes. The high degree of physiologic reactivity appears consistent with the assumption that the patient was definitely in contact.

The other catatonic patient exhibiting moderate galvanic reactions to crucial ideational stimuli (in range from 5.0 to 6.8) had been "withdrawn" since early childhood. She appeared to have highly developed narcissism which, because associated with a heavy growth of hair on the face and body, possibly led to her retreat into a catatonic state. She reacted to all questions with annoyance, pitiful anguish and sobbing. In the third test, made during such a disturbed period, there were even greater galvanic reactions.

The catatonic patients with small galvanic reactions showed characteristically a poverty of clinically observed reactions to adequate stimuli. One of these patients reacted only to threats or bribes. One showed barely perceptible reactions to external things, interrupted by explosive attacks of violence after inadequate stimuli. Two of these patients were in a slightly different class—one showed no visible affect during her hyperkinetic behavior, and the other showed an extreme evenness of mood even after what we considered to be disturbing stimuli. All except one were too "withdrawn" to react to sensory stimuli. In the case of one of these patients we were able to demonstrate that, even though no reaction was elicited by stimulation of the distance receptors, there was a definite galvanic reaction to such contact stimuli as hitting with light objects and pricking with a pin.

**Hebephrenic and Simple Schizophrenic Groups:** The hebephrenic patients (*H*) showed much less galvanic reaction after the crucial ideational than after other stimuli. This is, perhaps, what might have been expected as a concomitant of the marked accessory symptoms characteristic of this group. The patients classified as having simple schizophrenia (*S*) showed medium or larger reactions to all classes of stimuli. The difference in the reactions of the hebephrenic and the simple schizophrenic patients to the crucial stimuli is perhaps related to the fact that hebephrenic patients showed Bleuler's primary and accessory symptoms to a much greater degree than the patients with simple schizophrenia.

Two of the hebephrenic patients showed clinical evidence of fear, anxiety and apprehension, which appeared to have relation to the autistic rather than to the external world. These patients had low resistances (10,000 and 17,000 ohms). The patients with simple schizophrenia were of two types. Three showed well developed primary symptoms and moderate reactivity. Two showed a slight tendency to withdraw (these patients were of the type that might adjust well within an institution but poorly outside). The others showed less marked primary symptoms and gave larger galvanic reactions.

**Paranoid Group:** The patients with paranoid schizophrenia (*P*) showed no characteristic magnitude of galvanic reaction. A study of these patients reveals, however, that they may be clinically differentiated into groups which appear related to the degree of galvanic reactivity manifested.

All the patients had delusions of persecution which dominated the clinical picture. They differed in the degree of withdrawal, in the number of other accessory symptoms and in the state of clinical recovery. Of those that showed small galvanic reactions to crucial stimuli, two were definitely withdrawn, with the psychotic behavior apparently governed by the delusions of persecution. Two presented emotional attitudes inadequate to the situation, more or less disguised by superficial emotional attitudes made to fit the circumstances, so that they appeared eager to please and very cooperative. Two showed extreme sensitivity, morbid



irritability, rebellion and resentment. The latter two patients showed large reactions to sensory stimuli and practically negligible reactions to crucial ideational stimuli, giving either defiant answers or no answers. The seven paranoid patients showing large galvanic reactions showed an ideational response to their delusions. They were apparently disturbed by the fact that their delusional content was not satisfactory to society, or possibly, in one or two instances, had recovered sufficiently to wish to convince the examiners that they had forgotten their delusions.

**Toxic Group:** The patients in this group (*T*) showed rather consistently small galvanic reactions to crucial ideational stimuli and a tendency toward larger reactions to sensory stimuli.

One patient with a toxic psychosis, alcoholism and mental deficiency was given, during a repetition of the test procedure, two 2 ounce (60 cc.) glasses of alcohol. Following the first drink there was a marked decrease in the resistance level and a large increase in the galvanic and blood pressure reactivity to sensory stimuli, accompanied by a less marked but definite reduction of response to crucial ideational stimuli. This relation was accentuated by the second drink.

**Manic-Depressive Group:** The patients in this group (*M*) showed consistently large reactions to crucial ideational stimuli. This conforms with the belief that manic patients turn their energy outward.

Two patients were examined during typical manic excitement. One seemed to be somewhat disturbed by her own behavior, occasionally talking during the test in a serious vein, which may be related to the fact that she had a moderate initial resistance. The other patient was content and euphoric, with flight of ideas; she showed a much higher resistance level. It is interesting that sodium amytal (6 grains [0.36 Gm.] by mouth) caused the resistance of this patient to become twice as high, accompanied clinically by a greater degree of contentment. A third test without the administration of sodium amytal showed a duplication of the results of the first test.

An interesting manic patient for comparison with the paranoid patients is one who was antagonistic and bored during the test. A second test was performed while he was even more antagonistic. With the greater antagonism there was an increase in galvanic and blood pressure reactivity. The resistance level was the same in both tests.

**Diagnostic Groups in Relation to Blood Pressure Changes:** The relation of the diagnostic groupings to the blood pressure reactions shown in figure 13 shows a tendency (1) for the catatonic patients, with the exception of the one whose condition was classified as *Cp*, to give near-zero reactions to the crucial ideational stimuli and (2) for the paranoid group to show rather consistently large blood pressure reactions after crucial stimuli. This is significant in view of the tendency (fig. 11) for large blood pressure reactions to ideational stimuli to be associated with clinical irritability and aggressiveness. That a rise in blood pressure after ideational stimuli is peculiarly an aspect of the ideational defense processes, which may be exaggerated in the projection mechanisms of the paranoid patient (fig. 13), seems to be indicated. After mixed sensory stimuli the paranoid group gave either positive or minus changes and relatively few near-zero responses.

*E. Relation Between the Resistance Level and Clinical Evidence of "Free Energy" or "Free Anxiety."*—Our use of the terms "free energy" and "free anxiety" is to designate what we conceive tentatively as "bodily energy" which is liberated in anticipation of a need but which is not utilized in either normal activities or in certain psychopathologic mechanisms for achieving adjustment.

TABLE 1.—*Behavior Items Determining Ratings on Free Energy or Anxiety\**

|  | Number of<br>Patients<br>with<br>Symptoms | Rating of Patients      |      |      |       |
|--|---|-------------------------|------|------|-------|
|  |   | 4                       | 3    | 2    | 1     |
| Total number of patients rated.....                                      | 51  | 11                      | 11   | 13   | 16    |
| Symptoms   |   | Percentage with Symptom |      |      |       |
| Active somatic phobias; hypochondriac delusions                          | 3   | 100.0                   |      |      |       |
| Apparent uneasiness .....  | 7   | 57.2                    | 42.8 |      |       |
| Concern about and renunciation of previous<br>psychotic experience ..... | 6   | 50.0                    | 50.0 |      |       |
| Apprehension of physical consequences of test.....                       | 7   | 42.8                    | 57.2 |      |       |
| Apprehension of what test might prove.....                               | 17  | 35.3                    | 41.2 | 23.5 |       |
| Resistance to questioning; argumentative, critical,<br>angry .....       | 11  | 36.4                    | 45.5 | 9.0  | 9.1   |
| Concern about specific items.....  | 15  | 20.0                    | 26.6 | 26.7 | 26.7  |
| Ambivalent response and attitudes.....                                   | 6   | 16.7                    | 50.0 | 33.3 |       |
| Mania or hypomania.....  | 6   | 16.6                    | 50.0 | 16.7 | 16.7  |
| Rationalization of delusions.....  | 6   | ....                    | 66.7 | 33.3 |       |
| Confusion .....  | 5   | ....                    | 20.0 | 40.0 | 40.0  |
| Active delusions without concern about delusions                         | 9   | ....                    | 11.1 | 44.4 | 44.5  |
| Catalepsy .....  | 2   | ....                    | .... | 50.0 | 50.0  |
| At ease; outward calm.....   | 18  | ....                    | .... | 44.4 | 55.6  |
| Withdrawal or indifference during test.....                              | 18  | ....                    | 11.1 | 22.2 | 66.7  |
| Mutism .....   | 3   | ....                    | .... | 33.3 | 66.7  |
| Indifference .....   | 7   | ....                    | .... | 28.6 | 71.4  |
| Affective rigidity .....   | 4   | ....                    | .... | 25.0 | 75.0  |
| Dissociation between thought (verbal?) and<br>motor activity .....       | 5   | ....                    | .... | 20.0 | 80.0  |
| Catatonic stupor .....   | 2   | ....                    | .... | .... | 100.0 |

\* Maximum free anxiety is indicated by 4; minimum free anxiety, by 1. This table shows only the frequency with which the various symptoms or implied mechanisms occur in relation to the ratings on anxiety. In determining the extreme ratings of 1 and 4, the intensity of a given symptom was taken into consideration. The intermediate ratings of 2 and 3 were given when the symptoms were less severe or when, in the same patient, there were indications that in the presence of a mechanism conceived of as "freeing" energy or anxiety there was at the same time another mechanism assumed to render the energy or anxiety less "free."

TABLE 2.—*Average Resistance Levels of Patients with Various Ratings as to Free Anxiety*

| Ratings on free anxiety.....                             | 4    | 3    | 2    | 1    |
|--|------|------|------|------|
| Number of patients in group.....                         | 11   | 11   | 13   | 16   |
| (Total number of patients, 51)                           |      |      |      |      |
| Average Resistance* of Patients<br>Given Various Ratings |      |      |      |      |
| Initial resistance .....                                 | 13.5 | 20.9 | 33.8 | 63.1 |
| Average deviation .....                                  | 2.6  | 4.7  | 7.8  | 20.3 |
| Minimum resistance .....                                 | 10.9 | 14.4 | 22.7 | 47.5 |
| Average deviation .....                                  | 2.1  | 3.8  | 5.5  | 19.9 |
| Resistance before mixed series of stimuli.....           | 12.1 | 20.0 | 28.9 | 53.9 |
| Average deviation .....                                  | 2.9  | 5.6  | 8.1  | 20.9 |

\* Multiply by 1,000 ohms.

Since it is not employed in adjustment, it may be thought of as free to appear as some form of excess activity. Our thesis is that energy thus conceived as "free" may be manifest as overexcitation of the organism and appear psychologically as certain pathologic "anxiety" symptoms, which we shall designate "free anxiety," and physiologically as an overstimulation of the autonomic nervous system, which we shall designate "free energy." For purposes of description we shall use the terms interchangeably.

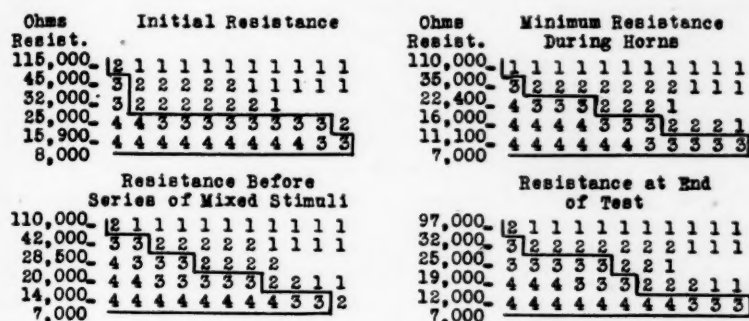


Fig. 14.—Histograms showing the relation of resistance levels to free energy or anxiety. In this and the following figure, 4 indicates maximum free anxiety, and 1, minimum free anxiety. Patients rated high as to free anxiety have lower resistance levels than those with minimum free anxiety.

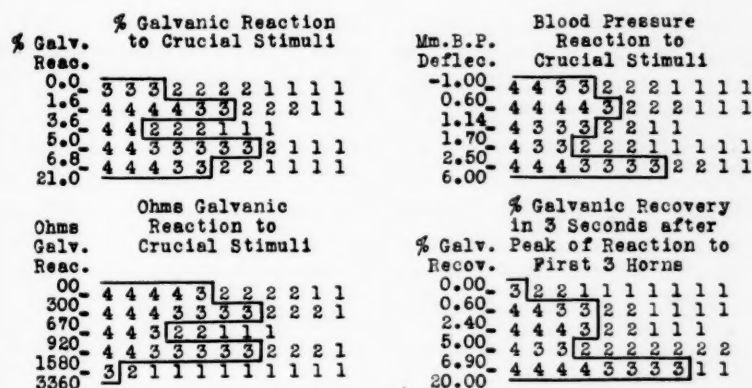


Fig. 15.—Histograms showing measures of reactivity in relation to free energy or anxiety. There is little if any relation of the per cent galvanic and blood pressure deflections to free anxiety but a definite positive relation between per cent immediate recovery and free anxiety. Larger absolute (ohms) reactions tend to characterize patients rated low as to free anxiety.

The clinical material for this phase of the study was secured from two sources: (1) the analysis of case histories as in the preceding sections of this paper and (2) personal observations on the behavior of patients during the test procedure and in the hospital, combined with further interpretation of available clinical notes. The ratings were made by one of us (S.) after the observations of Solomon and

Fentress<sup>12</sup> on psychoneurotic patients has revealed a striking correlation between free energy or anxiety and the resistance level.

The outstanding symptoms that were taken into consideration in determining the rating as to free anxiety are presented in table 1. Patients who manifest "anxiety" symptoms in the most severe form are given a rating of 4 on free anxiety. Those who exhibit psychotic mechanisms in which free anxiety is not apparent but in whom, on the contrary, appear to have developed psychotic or psychoneurotic mechanisms for the utilization or the inhibition (?) of the flow of energy, are given a rating of 1. A rating of 1 corresponds to what Solomon and Fentress<sup>12</sup> have referred to as a state of "bound energy or anxiety." Phobias, uneasiness and apprehension were apparent in the patients rated 3, and withdrawal, indifference, and catatonic stupor were present in the patients rated 1.

There is a clearcut tendency, evident in table 2 and in figure 14, for patients rated high as to free anxiety to have low palmar resistance, and for those rated low to have high resistance. It will be noted in figure 15, on the other hand, that the reactions to stimulation do not manifest relationship to free anxiety in nearly the degree shown by the resistance level. Blood pressure and per cent galvanic reactions show little or no relationship to this measure. Galvanic reaction measured in absolute units (ohms), however, is large in patients rated 1, indicating the least free anxiety, and small in patients rated 4, indicating maximum free anxiety.

The large absolute galvanic reactions by persons with the least free anxiety (who generally have relatively high resistance) are attributable to the physical fact that they are farther removed from their minimum resistance and that there is, therefore, a greater range of resistance through which they may react under stimulation. While we believe, as already pointed out, that the calculation of galvanic reactions in percentage gives a better index of the degree of physiologic and psychologic activity involved in a reaction, it seems likely as suggested by these data on free anxiety, that the absolute change in resistance may be a better index of the degree to which a stimulus occasions a change in the physiologic and psychologic state.

**Mode of Recovery:** Observations indicate that another factor which will prove of great importance is the shape of the galvanic curve both as to reaction and as to recovery. The galvanic recovery (the change in ohms from the peak of the reaction) in three seconds after the peak of reaction (expressed in figure 15 as percentage of the absolute resistance at the peak of reaction) shows a definite tendency for persons with greater "free energy or anxiety" to manifest a greater degree of change. In a previous study,<sup>3d</sup> the rate of immediate galvanic recovery was shown to increase with strong and prolonged excitation, with the amount of visible perspiration and with a low resistance level at the moment of the stimulus.

#### COMMENT

*A. Relation Between Physiologic Subnormality and Subnormal Reactivity to Stimulation.*—The relation of reactivity, especially of galvanic reactivity, to the physiologic status of the patients as here observed is in conformity with earlier results on "normal" persons,<sup>1</sup> in which galvanic reaction under seven different conditions manifested a relation

12. Solomon, A. P., and Fentress, T.: Galvanic Skin Reflex and Blood Pressure Reactions in the Psychoneuroses, *J. Nerv. & Ment. Dis.*, to be published.

to physiologic subnormality. Other investigators have observed similar relationships, notably W. S. Brown,<sup>13</sup> who found the magnitude of galvanic deflections related to "soundness of constitution," and Cattell,<sup>14</sup> who noted a relation to good physical condition.

That good health should be associated in a general way with a maximum capacity of the tissues to change their permeability in response to changing conditions is perhaps to be expected. That it should, more specifically, be associated with a maximum of galvanic reactivity in the skin is not so obvious. Clinical evidence shows pathologic changes associated not only with hypo-activity of the sweat glands but with hyperactivity as well, and it appears at first thought strange that both of these conditions should be associated with slight galvanic reactivity. We can easily account for our results in conditions of physiologic hypo-activity which are associated with an atrophic skin, subnormal metabolism or exhaustion. Fever, likewise, is commonly characterized by subnormal sweat gland activity, and we are not surprised that even disease conditions not sufficiently severe to raise the body temperature may reduce sweating. On the other hand, pathologic conditions of the opposite extreme, involving hyperhidrosis, are also sometimes associated with subnormal galvanic activity. We can account for this apparent paradox best by assuming that permeability of the tissues is here so close to the physiologic limit that there is little opportunity for further change under stimulation.<sup>15</sup> It is apparently in the intermediate and more normal range of sweat gland activity that the greatest changes in resistance after stimulation are likely to occur.

The old question of the relation of organ inferiority to the psychoses is raised by the fact that subnormal reactivity bears a relation also to the mental status of the patient, as appears in the material presented under section B. The special significance of the data for the problem lies in the fact that in our records of reaction to stimulation we have measures which are both obviously physiologic and obviously psychologic. Inferiority in organic reaction to peripheral stimuli is, in other words, according to these measures both an organic and a psychologic inferiority. It is, we believe, in such observations in the field where abstractions of the mental from the physical aspects of personality overlap that one may eventually trace the connection between psychotic tendencies and abnormal bodily conditions.

13. Brown, W. S.: A Note on the Psychogalvanic Reflex Considered in Conjunction with Estimates of Character Qualities, *Brit. J. Psychol. (Gen. Sect.)* **16**:130, 1925-1926.

14. Cattell, R. B.: Experiments on the Psychical Correlate of the Psychogalvanic Reflex, *Brit. J. Psychol. (Gen. Sect.)* **19**:357, 1929.

15. Darrow, C. W.: Considerations for Evaluating the Galvanic Skin Reflex, *Am. J. Psychiat.* **13**:285, 1933; Simultaneous Galvanic Reactions in Different Skin Areas, *Psychol. Bull.* **29**:674, 1932.



Furthermore, the extensive evidence from the literature suggesting organic factors in the psychoses appears especially applicable in accounting for a reduction of reactions under conditions suggesting organic inferiority. The circulatory deficiency frequent in schizophrenic (catatonic and hebephrenic cases) as demonstrated by Lewis,<sup>16</sup> the less marked difference when the paranoid cases are not separated from the others shown by Fulstow,<sup>17</sup> the low circulatory rating shown by Trentzsch,<sup>18</sup> the prevalence of cyanosis shown by Cornell,<sup>19</sup> the long recognized predisposition toward tuberculosis illustrated by Freeman,<sup>20</sup> and the important "factor of sudorific delay" under standard increases in temperature shown by Chevens and Mumford<sup>21</sup> are but a part of the accumulating mass of evidence relating to subnormal physical and abnormal mental conditions and accounting for, or at least consistent with, the subnormal galvanic and circulatory reactivity which we have observed.

*B. Reaction to Stimulation in Relation to Insight, Attention and Withdrawal.*—The relationships here observed between small reactions to stimulation and insight, attention, withdrawal and lack of sociability do not answer the academic question whether or not the poor attention and other phenomena are the cause of the small reactions or whether the small reactions cause the poor attention, etc. We are not offering a conclusive answer even when we adopt the motor theory of mental activity and assume that reaction is basic to mental life. Nor do the data tell whether the small reactions and poor attention, etc., are due to a common cause (e. g., the subnormal physical condition shown to be associated with subnormal reactivity). We note, nevertheless, the interesting fact that in the case of the blood pressure reactions only the ideational stimuli, and among these especially the crucial stimuli, tend to produce the small effects in patients with poor attention, poor insight, inaccessibility, withdrawal, etc. This is suggestive of a difference in the significance of the blood pressure and galvanic reactions of the sort which has appeared in previous work.

16. Lewis, N. D. C.: Pathology of Dementia Praecox, *J. Nerv. & Ment. Dis.* **62**:225, 1925; The Constitutional Factors in Dementia Praecox, Nervous & Mental Disease Monograph Series, no. 35, Washington, D. C., Nervous and Mental Disease Publishing Company, 1923, p. 135.

17. Fulstow, M.: Weight of Heart in Schizophrenia and in Other Mental Disorders, *Arch. Neurol. & Psychiat.* **16**:620 (Nov.) 1926.

18. Trentzsch, P. J.: Objective Findings in Psychoses, *Arch. Neurol. & Psychiat.* **12**:370 (Oct.) 1924.

19. Cornell, W. B.: Cyanosis in Dementia Praecox, *J. A. M. A.* **59**:2208 (Dec. 21) 1912.

20. Freeman, W.: Biometrical Studies in Psychiatry: The Chances of Death, *Am. J. Psychiat.* **8**:425 (Nov.) 1928.

21. Chevens, L. C. F., and Mumford, P. P.: The Sudorific Reaction in Certain Types of Psychosis, *J. Ment. Sc.* **72**:331, 1926.



In an earlier study on presumably normal persons,<sup>10</sup> a tendency was observed for sensory stimuli to produce large galvanic and small blood pressure reactions, and for "disturbing ideational" stimuli to occasion large blood pressure and relatively small galvanic effects. From this study and an extensive review of the literature,<sup>10b</sup> one of us inferred that blood pressure changes are more definitely linked with the perceptual and ideational processes than are the peripheral galvanic, sudoral and vasoconstrictor changes. It was inferred that a rise in blood pressure represents a higher adaptive or genetic level of reaction than the galvanic skin reflex. The fact that momentary sensory (startling?) stimuli occasion large galvanic responses was believed attributable to the absence after such stimuli of appropriate neural organization (habits?) for adequate perceptual and adjustive response. One may think of the impulses aroused by such stimuli as being short-circuited at a low neurologic level, causing, possibly by irradiation, the generalized galvanic and other peripheral reactions. Ideational stimuli, on the other hand, find the higher brain mechanisms already prepared by past experience for the apperceptive elaboration of the stimuli and the delay of the responses. The blood pressure reactions which follow such stimuli are, perhaps, miniatures of the changes which might occur if motor and other adjustments appropriate to the associations aroused were carried out in overt behavior.

*C. Relation Between a Large Rise in Blood Pressure After Ideational Stimuli and the Apparent Exaggeration of the Patient's Defense" or "Projection" Mechanisms.*—Not only is there reason to connect blood pressure reactions with the perceptual and ideational processes, but there is evidence that these reactions are most pronounced when the intellectual functions serve the primitive ends of self-preservation. Evidence offered by Lewis<sup>16</sup> of an enlarged heart and aorta in paranoid patients, in whom the psychic defensive and projection mechanisms are most frequently exaggerated, therefore seems more than a coincidence. The significance of blood pressure changes in relation to the defensive and adjustive functions has been discussed at length by Cannon in relation to suprarenal function.<sup>22</sup> That humoral conduction of epinephrine could effect a momentary rise in blood pressure with sufficient rapidity to occasion the immediate and fleeting changes here under investigation seems highly improbable, although the evidence of frequent hyperplasia of the suprarenals in paranoid patients offered by Lewis is of interest in this connection. It is much easier to believe that the changes we are concerned with are due directly to nerve conduction. Whatever the mechanism, the biologic significance of these changes need not be

22. Cannon, W. B.: *Bodily Changes in Pain, Hunger, Fear, and Rage*, New York, D. Appleton and Company, 1929, chap. 12.

different from those more pronounced and more lasting effects attributed to the sympathicomimetic action of epinephrine.

*D. Relation of Reactions to the Individual Traits and Diagnostic Grouping of the Patients.*—The data on the relation of our measures to the clinical classifications of the patients do not at present justify discussion further than the descriptive treatment previously given. The available results suggest that we may not expect a differentiation of the psychoses by our data on reaction except as we take into consideration their relation to the stimulating situations and the physical condition of the patient at the time of the test.

*E. Relation Between the Resistance Level and Clinical Evidence of "Free Energy" or "Free Anxiety."*—Briefly, energy which is liberated in anticipation of a need but which is not utilized in adjustive processes may be conceived of as "free" and may be manifest psychologically as certain pathologic "anxiety" symptoms and physiologically as an overstimulation of the autonomic nervous system. We present first a statement of certain premises. Without reviewing the evidence, we shall assume (a) the generally accepted view that the galvanic skin reflex is primarily controlled through the sympathetic segment of the autonomic system.<sup>23</sup> We shall assume further (b) that while it is one of many autonomic functions, and does not manifest invariable concomitance with other autonomic changes, an increase or decrease in its activity is more or less symptomatic of the level of autonomic activity. The demonstrated relation of galvanic activity to sweat secretion leads to the assumption (c) that changes in resistance, at least in certain skin areas, are effected by the temperature control mechanisms of the body. Secretory activity also, for reasons to be elaborated in the next paragraph, (d) serves to maintain the pliability and adhesiveness of the palmar and plantar surfaces essential to high cutaneous sensitivity and good grip which (e) plays a rôle in preparing the organism to make physical adjustment to its environment. With the tentative acceptance of these premises, we are in a position to interpret our data.

*Significance of Sweat Secretion in the Palm:* That the sweat secretion (and associated changes in) resistance in the palms and soles may perform a function directly related to the self-preservative, manipulative and perceptual functions, as already suggested, seems obvious. Sweat secretion in these surfaces, as pointed out,<sup>24</sup> assists in the maintenance of the pliability and adhesiveness of the skin essential to high

23. Gildermeister, M.: Der galvanische Hautreflex als Teilerscheinung eines allgemeinen autonomen Reflexes, Arch. f. d. ges. Physiol. **197**:432, 1922.

24. Darrow, C. W.: The Functional Significance of Sweat Gland and Galvanic Activity in the Palm and Back of the Hand, Psychol. Bull. **30**:712, 1933.

tactual sensitivity<sup>25</sup> and firm grip in the hypothetic primitive situations demanding mobilization of the bodily energies for offense, defense or flight from danger.<sup>25a</sup> The preparation of the four body surfaces most concerned in contacting and manipulating the environment may be regarded as one of those many vegetative changes which take place when the organism is mobilized for action. In a hypothetic primitive environment such preparation would serve most effectively if it occurred when there was a sense of impending danger—e. g., an occasion for anxiety. Lacking a sense of such impending danger, the organism would be best served if the palmar and plantar surfaces were quickly moistened, as normally happens when a person is suddenly startled.

The resistance of the palm, according to these assumptions, may therefore be physiologically and psychologically significant in two ways: (1) as an index of the extent of the mobilization of the organism in general and of the vegetative system in particular in anticipation and preparation for new adjustments and (2) as an indication of the degree to which energy (heat?) production in the body exceeds the facilities for its dissipation by other means than sweat secretion.

When excessive energy, liberated under conditions involving anticipatory reactions to real or imagined situations, affects the vegetative functions, the palmar resistance, as we have shown, is likely to be low because of marked sweat gland activity. In psychotic and psychoneurotic patients, however, the situations which might give rise to anxiety are sometimes met by such mechanisms as conversion hysteria, compulsion neurosis and those diverse psychotic mechanisms which are essentially of the nature of withdrawal. Under such conditions the vegetative functions are no longer overstimulated, as when free anxiety is present. On the contrary, they may give evidence of an exaggerated relief and abnormal inactivity,<sup>26</sup> as indicated by an excessively high palmar resistance level. Of this we apparently find confirmation in Cattell's observation<sup>27</sup> that normal persons show a marked relation of resistance level to freedom from mental conflict as indicated by various symptoms.

25. Katz, D.: *Der Aufbau der Tastwelt*, Leipzig, Johann Ambrosius Barth, 1925, p. 176.

25a. Y. Kuno reached essentially this conclusion regarding the function of sweat in these areas. He showed (*Lancet* 1:912, 1930) that sweating of the palms and soles is specific for what he termed "mental stress" and that sweating elsewhere on the body occurs in conditions which involve a rise in temperature.

26. Jelliffe, S. E., and White, W. A.: *Diseases of the Central Nervous System*, Philadelphia, Lea & Febiger, 1929, p. 1042.

27. Cattell, R. B.: The Significance of Actual Resistance in Psychogalvanic Experiments, *Brit. J. Psychol.* 19:934, 1928.

Richter<sup>28</sup> has also reported numerous clinical data consistent with our interpretation.

The resistance levels of patients must be interpreted also in the light of the observed changes occurring under stimulation. Some patients with high resistance may respond little to the test situation, while others may give large reactions. Some of those with large reactions may immediately recover from the drop in resistance incidental to stimulation, while in some the fall in resistance may be relatively enduring and establish, as it were, a new level. We cannot in this paper present the extensive evidence on which we base our interpretation, but it may not be amiss briefly to state the apparent relationships.

In patients in whom free anxiety has become chronic, as in those with chronic anxiety neuroses, low resistance, as shown by Solomon and Fentress,<sup>12</sup> is more or less continuously present. In persons with temporarily acute anxieties or fears, as in phobic and psychotic patients during disturbed episodes, the resistance level appears to be only temporarily near the minimum. In patients who clinically show variability in these respects there has generally been corresponding variability in the resistance level. In patients with conversion hysteria Solomon and Fentress found a high resistance level, generally accompanied by large galvanic reactions to stimulation save in the actual presence of an acute conversion attack. During the attack the resistance rose still higher, and the reactions to stimuli became small. In other words, there was a reduction in the amount of free energy or anxiety as well as an increase in the amount of what Solomon and Fentress have termed "bound" energy as a result of adjustments achieved by the conversion mechanisms. These authors expressed the belief that there is also an increased "stability of binding" of the energy. Our psychotic patients having high resistances likewise display differences in reaction. On the one hand, those who are highly withdrawn generally show small reactions (see section B), while those in good contact with the outside world generally have large reactions. This may be interpreted as indicating in the more withdrawn, less reactive patients a reduction in the free energy available for reaction. The correlation presented in section A, showing a relation between our measures of reaction and the ratings on physical condition, such as nutrition, is consistent with this interpretation.

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28. Richter, C. P.: The Electrical Skin Resistance: Diurnal and Daily Variations in Psychopathic and in Normal Persons, *Arch. Neurol. & Psychiat.* **19**:488 (May) 1928; Pathologic Sleep and Similar Conditions Studied by the Electrical Skin Resistance Method, *ibid.* **21**:363 (Feb.) 1929.

CONCLUSIONS

A study of clinical data on psychotic patients in relation to their resistance levels and their blood pressure and galvanic skin reflex reactions to sensory, indifferent ideational and crucial ideational stimuli shows:

1. Both small changes in blood pressure and small galvanic skin reflex reactions tend to be associated with impairment of the physiologic functions of the body.
2. Small blood pressure reactions to crucial ideational stimuli together with small galvanic reactions to all forms of ideational and to sensory stimuli tend to be associated with lack of "contact with reality."
3. The combination of small galvanic reactions to ideational stimuli with large blood pressure reactions to these stimuli tends to be associated with irritability and related manifestations.
4. A relation appears to exist between a large amount of free energy (or anxiety) and low electrical skin resistance and between a small amount of free energy and high electrical skin resistance.
5. The nature of the stimulus used, including its emotional value, and the physiologic and emotional state of the patient at the time of the test are essential considerations in the interpretation of the galvanic skin reflex and blood pressure reactions in clinical studies.



## CHORDOMAS OF THE CRANIUM AND CERVICAL PORTION OF THE SPINE

REVIEW OF THE LITERATURE WITH REPORT OF A CASE

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The recent observation in the Peter Bent Brigham Hospital of a patient who died of a spheno-occipital chordoma led to a perusal of the literature in search of similar cases. The apparent rarity of these tumors, especially in this country, afforded sufficient stimulus for the preparation of a brief review. This study is restricted to a collected series of fifty-six chordomas which caused clinical symptoms by involvement of structures within the cranial vault or in the region of the cranium, the cervical portion of the spine and the nasopharynx. Even though the subject-matter is only complementary, it may serve a purpose and perhaps will revivify interest in this unique group of tumors.

A chordoma is a neoplasm rising from embryonic rests of the chorda dorsalis. The benign form, which has been named *ecchordosis physaliphora*, is a curiosity of no clinical importance. The malignant form is usually characterized by slow expansile growth, infiltrative lacunar destruction of bone, infrequent invasion of the soft tissues, almost invariable local recurrence after excision and, rarely, metastasis. The typical tumor is traversed by fibrous septums, between which there is a sparsely cellular tissue composed largely of an intercellular matrix of gelatinous or mucinous character. In its microscopic structure the histology of the evolution of the chorda dorsalis is reduplicated.

### REVIEW OF THE LITERATURE

Virchow (1856) recorded the first description of a chordoma. This was a small tumor on the clivus *Blumenbachii* in the neighborhood of the spheno-occipital synchondrosis. In 1857, because of the physaliphorous nature of the tumor cells and because of his belief that they were of cartilaginous origin, Virchow named the tumor *ecchondrosis physaliphora spheno-occipitalis*. H. Müller (1858), after a comparative study of the basilar cartilage of man and animals, concluded that the tumor originated from embryonic rests of the chorda dorsalis. Ribbert, in 1894, confirmed the views of Müller, and applied the name chordoma. In the following year he strengthened his opinion by experiments in

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which herniations of the nucleus pulposus were produced by the puncture of the intervertebral disks of rabbits. The experimental tumor was so similar histologically to the chordoma that he was inclined to consider the two as of identical nature. In a series of five hundred autopsies he found ten instances of small benign chordomas of the type described by Virchow.

Little has been added to the early histologic descriptions of Virchow and his contemporaries. Nebelthau (1897) identified glycogen in the cytoplasmic vacuoles. Alezais and Peyron (1914) described in detail the histogenesis and evolution of the tumor. Stewart and Morin (1926) suggested the more appropriate name, *ecchordosis physaliphora*, for the benign tumor (chordal ectopia) so as to segregate it from the true neoplasm or chordoma.

The first probable instance of a symptomatic or malignant chordoma was reported by Klebs (1864). Grahl studied the first sphenoccipital chordoma of clinical importance. Since his report a number of tumors which occurred in the region of the base of the skull have been added to the literature: Seiffer, Fischer and Steiner, Kon, Linck, Frenkel and Bassal, Jelliffe and Larkin, Eitel, Spiess, Wegelin, Hässner, Kotzareff, Argaud, Daland, Fabricius-Möller, Hellmann, Swars, Lemke, Mathias, Hirsch (1923), Burrow and Stewart, Arauz and Podestà, André-Thomas and Jumentié, Grossmann, Filippini, Eckel and Jacobs, Citelli, Castex and Camauër, Camauër, Llambias and Mortola, Sedláčkoviá-Šikl, Argaud and Clermont, Loebell, Baily and Bagdasar (two cases), Herrmann (one case, 1929, 1932), Pavlica, Alajouanine, de Martel, Oberling and Guillaume, Goerke, Machulko-Horbatzewitsch and Rochlin, Rocher and Guérin, Klotz, Stanton and Selinsky.

The first probable tumor which arose from the cervical portion of the spine was described by Trélat in 1868, and was diagnosed by Ranvier as an "ecchondrome muqueux." Heine extirpated a tumor mentioned by Klebs (1889) as a probable cervical chordoma. Syme and Cappell, in 1926, reported the first well established instance. This involved the three upper cervical vertebrae and encroached on the nasopharynx. Descriptions of other tumors of this region soon followed by Cappell, Chiari, André-Thomas and Villandré, Owen, Hershey and Gurdjian and Joyce.

The chordomas which were encountered in unusual situations were those described by Alezais and Peyron (1914) in the left superior occipital region, Koritzki in the alveolar processes of the mandible and superior maxilla, Rubaschow in the superior maxilla and Hirsch (1931) in the tonsillar region.

Although the attention of the early observers was concentrated on the cranial tumors, chordomas which arose from other parts of the *chorda dorsalis* were gradually recognized. These were most frequent

in the sacrococcygeal region, and at least fifty have been recorded since the early descriptions of Hennig, Mazzia and Feldmann. Rarely, tumors have been described in the dorsal and lumbar regions of the spine.

Excellent reviews of the subject were written by Stewart, Coenen, Stewart and Morin, Jelenjewsky and Melnikow and Machulko-Horbatzewitsch and Rochlin.

#### EMBRYOLOGY

The physical characteristics, the histologic peculiarities and the anatomic localization of chordomas cannot be appreciated without some conception of the evolution of the chorda dorsalis (Müller, Ribbert, von Kolliker, Williams and Bardeen).

The chorda dorsalis constitutes the primitive axial skeleton of all vertebrates. It differs from all other skeletal elements in that it is generally regarded as a derivative of the entoderm. In embryos of from 2 to 3 mm. the cells of the entoderm in front of the anterior end of the primitive streak and just ventral to the neural groove differentiate slightly to form the chordal anlage. A groove with a ventral concavity is formed. The cells of the groove close in, become constricted from the entoderm and are soon surrounded by mesodermal tissue. The chorda at this stage is a solid cylindric rod composed of closely approximated polyhedral cells.

The developing notochord extends as far forward as the buccopharyngeal membrane, and temporarily remains attached to its caudal wall as the hypophyseal pocket forms. The chorda makes a single large sigmoid curve in the midsagittal plane of the basilar plate of the skull, lying near the dorsal surface of the cartilage at three points: in the hypophyseal fossa, a short distance caudad to the fossa and anterior to the foramen magnum. It is near the ventral surface midway between the hypophyseal fossa and the foramen magnum. As the base of the skull is molded, the posterior end of the cranial part of the chorda is forced backward and dorsad, so that it lies on the occipital plate in a dorsal groove anterior to the foramen magnum. The anterior extremity is forced forward so as to lie between the cartilage and perichondrium of the dorsum sellae. The middle part comes to lie between the cartilaginous occipital plate and the dorsal wall of the pharynx. This middle segment often presents a number of kinks, branches and irregularities. Frequently it is embedded in the retropharyngeal tissues, and its cells may intermingle with the epithelial cells of the pharynx.

From the dorsal surface of the basilar process of the occipital bone at the anterior margin of the foramen magnum the notochord is continued into the mesoderm which eventually gives origin to the apical odontoid ligament. This is regarded as a rudimentary intervertebral fibrocartilage, and remnants of notochord may persist in it (Müller).

The notochord can be traced from the anlage of the apical odontoid ligament dorsal to the hypochordal bar which gives origin to the anterior arch of the atlas. From this level to within a short distance of its caudal extremity it is enveloped in mesoderm from which the dens epistrophei and the vertebral bodies arise. As condensation of the mesenchymal anlage of the vertebral bodies progresses the cells of the chorda are gradually extruded into the intervertebral regions. During this period vacuolation and mucoid degeneration of the notochordal cells appear. By the time the vertebral bodies have assumed the morphology of cartilage, the notochordal cells, as a rule, are confined entirely to the central portions of the intervertebral disks. The chordal cells gradually undergo adaptive changes, and aid in forming the nucleus pulposus. The original tract of the chorda in the vertebrae is marked by a streak of mucoid material, but cells may persist here (although less frequently than in the nucleus pulposus) well into adult life. These rests, which may be found from the hypophyseal fossa to the sacrococcygeal region, therefore, are of fundamental significance in the localization, histogenesis and evolution of chordomas.

#### CLASSIFICATION

In the evolution of the notochord the sites at which the chordal tissue escaped envelopment by cartilage were emphasized in the literature as follows: on the dorsum sellae, in the epipharynx, on the dorsal surface of the occipital plate anterior to the foramen magnum, in the apical odontoid ligament, the intervertebral disks, the vertebral bodies and the sacrococcygeal region. In these general locations, almost all chordomas were found. The few tumors which were in atypical positions presumably originated from chordal tissue which was displaced for unusual distances by the developing cartilage.

After a correlation of the facts of embryology with the clinical aspects of chordomas, Coenen evolved the following classification: (1) cranial chordomas, including the clivus chordoma (both benign and malignant), the hypophyseal chordoma, the nasopharyngeal chordoma and the dental chordoma (from the region of the dens epistrophei); (2) vertebral chordomas, and (3) caudal or sacrococcygeal chordomas, including the antesacral, retrosacral and central forms.

This classification, which has been accepted by most research workers, will be referred to in the subsequent discussion. However, the task of "labeling" tumors by placing them in certain subdivisions of this grouping was perplexing and often impossible, so that recourse was made to a general rather than to a strict categorical consideration.

#### INCIDENCE AND ETIOLOGY

*Age.*—The majority of the tumors caused the first symptoms in the third, fourth and fifth decades of life. The average age was 36 years.

The youngest patients, who were 1 day (Rubaschow) and 1½ months (Koritzki) old, had tumors in unusual situations. The earliest symptoms of a clivus tumor began in one patient at 5 years of age (Arauz and Podestà). The oldest patient, who was 82, had a history of only three years' duration (Pavlica).

*Sex.*—The tumor was found more frequently in males than in females, in a ratio of 3:2.

*Cause.*—The factors which excited neoplastic proliferation were unknown, but the frequency of the history of trauma deserved emphasis (Bérard, Dunet and Peyron). It is known that if chordal cells escape from the enveloping cartilage they undergo a typical morphosis and form adult chordal tissue, which is in all essentials like that found in many chordomas. If this same process takes place in the base of the skull one would expect to find notochordal tissue forced by the first chondrification of this region, that of the dorsum sellae, either forward into the hypophyseal fossa or backward and upward on the dorsum sellae. The chondrification of the posterior end of the parachordal plate would, under the same conditions, force the notochord backward toward the dens epistrophei or forward. In the latter instance the chordal tissue would be forced either out into the retropharyngeal tissue or forward to the junction of the sphenoidal and occipital cartilages or bones. Williams stated that most chordomas were comparable to cranial nuclei pulposi growing normally in an abnormal situation. This may well be applied to the benign ecchordosis physaliphora, but can hardly explain the frankly malignant properties of many chordomas.

#### GROSS ANATOMY

Although instances of benign chordomas or ecchordoses were not included in this review, the following description may be of value as a means of comparison with malignant chordomas. The ecchordoses were usually pedunculate, small (from 1 mm. to 3 cm.), soft, semitransparent and white or pale gray. Occasionally they were firm and either lobulate or nodular. The characteristic situation was beneath the pons along the course of the basilar artery. In typical instances they were attached to a small, median exostosis of the clivus by a narrow stalk which perforated the dura. The stalk was not always found, and in these instances the tumor either lay in the subdural space or nestled beneath the dura against the bone of the clivus. Either at or adjacent to the base of a few ecchordoses there were islands of cartilage, exostoses, ecchondroses and small perforations in the bone. These benign tumors of the clivus, first described by Virchow, were of no clinical importance. Similar tumors, which arose chiefly from the vertebrae or intervertebral disks, were described by Kirschberg and Marchand and Schmorl.

The segregation of the benign tumors from the malignant chordomas, as a rule, was not difficult. The malignant tumors usually arose along the course of the chorda dorsalis, although rarely they were encountered in atypical positions. They varied in size from small (from 2 to 3 cm.) tumors to massive neoplasms, the largest of which was 11 by 7 by 6 cm. (Jelliffe and Larkin). In form they were pedunculate, mushroom-like, globular or diffuse. On the clivus they were usually covered by the dura, and in the nasopharynx they were limited by the mucosa.

The typical chordoma was usually well encapsulated by fibrous tissue which was continuous with the narrow septums of connective tissue that divided the tumor into irregular lobules. These lobules were composed of soft, mucinous or gelatinous tissue which was semitransparent or translucent. The softer portions were pale bluish gray, while the firm lobules were pale white, opaque and less gelatinous. A predominance of firm opaque lobules usually indicated a more rapid rate of growth, increased cellularity and a heightened tendency toward the invasion of regional tissues. Foci of necrosis with hemorrhage were not uncommon. Cystic degeneration with calcification was infrequent. Bits of cartilage, clumps of sequestered bone and islands of newly formed bone were observed in several instances, especially in regions in which the neoplasm was in contact with bone. The invasion of bone was characterized by irregular lacunar resorption, and reactive osteogenesis was never prominent. The widespread infiltration of soft tissues was rare. Within the cranium, the dura mater, pia mater, pons, pituitary and temporal lobes were invaded in isolated instances. The mucosa of the nasal fossae, paranasal sinuses and pharynx usually was elevated in a characteristic manner by the slowly infiltrative, expanding growth. There was extension into veins in only five cases (Hellmann, Wegelin, Hässner, Fischer and Steiner, and Kotzareff) and into lymphatics in one instance (Hellmann). Kotzareff described metastases in lymph nodes, and in one case (Jelliffe and Larkin) it was thought that there was tumor tissue in the dorsal portion of the spine and in the sacrum, as well as in the cranium.

The majority of the cranial chordomas arose from the clivus in the region of the spheno-occipital synchondrosis. Characteristically, they were located in the median line beneath the dura. They presented as moundlike, slightly irregular, nodular, elastic, fairly firm eminences which were fixed to the bone by a broad zone or peduncle. There was a tendency to symmetrical growth in the horizontal plane, and the ventral, anterior and posterior extensions usually were in the midsagittal plane of the skull.

The typical ventral extension was in the direction of the nasopharynx. It was common for the basilar plate to be infiltrated and partially destroyed. Somewhat less frequently a smooth, round mound of tumor



elevated the mucosa in the midline of the posterior epipharyngeal wall. These growths extended for variable distances anteriorly and caudally, although as a rule they were restricted to the vault of the epipharynx. In exceptional instances tumor tissue pressed through the posterior choanae into the nasal fossae and even into the maxillary antrums. In other instances caudal extensions, which sometimes infiltrated the vertebral bodies, reached the level of the fourth and fifth cervical vertebrae. Contrary to expectations the volume or extent of the nasopharyngeal growth did not parallel the size of the intracranial neoplasm in the majority of the cases. Several intracranial tumors had no associated involvement of the nasopharynx. Furthermore, nasopharyngeal chordomas were described in patients who had no signs or symptoms referable to a tumor at the base of the brain.

The involvement of tissues directly beneath the region of the sphenoccipital synchondrosis often was either absent or of less importance than the spread of the tumor elsewhere. There was a tendency for growth to proceed along the track of the primitive notochord. The anterior and posterior extensions, singly or together, occurred in approximately the same number of instances.

In several tumors the progression anteriorly was characterized by erosion of the sella turcica, expansion of the hypophyseal fossa, displacement or invasion of the hypophysis and compression of the optic chiasm. The pressure on the optic tracts was exerted in such a way that the defects of the visual field simulated those commonly produced by primary tumors of the hypophysis. In the region of the diaphragma sellae the tumors not infrequently penetrated the dura, and in rare instances expanded so as to encroach on the middle fossa or infiltrate the temporal lobe. Whenever anterior extension occurred it was customary to find ventral invasion of bone and soft tissues. The infiltration of bone which was usually symmetrical was not always restricted to the basisphenoid and the body and sinuses of the sphenoid bone. The regional petrous portions of the temporal bones, the ethmoid sinuses as far forward as the crista galli and the osseous walls of the orbital cavities occasionally were involved. It was fairly characteristic of this widespread anterior growth to be associated with ventral invasion into the walls of the nasal fossae and into the superior maxillary bones with the tumor encroaching on the nasal cavities, the maxillary antrums and the soft tissues of the face. Although involvement of the bones of the forehead and the parietal bones was never found, in one instance the temporal bone was penetrated by tumor which continued its invasion into the temporal muscle.

In several instances the posterior extension of tumors from the region of the sphenoccipital synchondrosis along the clivus was unassociated



with growth toward the hypophyseal fossa. As a rule, the largest mass was at the synchondrosis, and the tumor diminished in size as it approached the foramen magnum. The typical tumors were median in position and beneath the dura. The lateral spread across the floor of the posterior fossa usually was symmetrical, although in one case the growth was largely to one side of the midline. Rarely, the dura was infiltrated or penetrated by the tumor. More commonly there was a variable degree of destruction of the basilar process of the occipital bone and proliferation of tumor in the underlying retropharyngeal tissues.

The extension of tumors along the clivus was of fairly uniform character, but at the foramen magnum individual variations were the rule. The tumors occasionally were gradually attenuated at the anterior margin of the foramen. One tumor arose just anterior to the foramen. In another instance the tumor terminated at the tip of the dens epistrophei; in another it eroded the odontoid process, and in others it passed anteriorly beneath the basilar process of the occipital bone into the retropharyngeal tissues or laterally into the paravertebral tissues. The growth downward into the spinal canal was never for a greater distance than a few centimeters. In these instances the tumor was situated ventral to the cord and outside the dura.

The chordomas which arose from the anterior extremity of the chorda dorsalis usually primarily involved the body of the sphenoid bone and encroached on the hypophysis and suprasellar structures in such a way as to simulate hypophyseal tumors or craniopharyngiomas. It is of interest to note that chordal tissue formed a part of possible mixed tumors in this region (Kon, Selinsky, [?] Bailey and Bagdasar, case 2). The essential features of their tendencies in growth were the same as those of tumors of the clivus, namely, local invasion and destruction of bone, extension into the mucosa of the nasopharynx and compression of the regional intracranial structures.

The tumors which rose from the cervical vertebrae or intervertebral disks were of essentially the same morphologic character as the chordomas of the clivus. They were described as either arising from or involving various vertebrae from the atlas to the sixth cervical vertebra. Those which grew anteriorly involved the retropharyngeal tissues in variable positions from the epipharynx to the level of the larynx. Usually they were smooth, rounded, firm tumors situated close to the median line. The chordomas which apparently arose from the posterior portions of the vertebral bodies or intervertebral disks spread out beneath the dura and compressed the spinal cord. In two instances lateral extensions were palpable in the posterior cervical triangle. The osseous structures usually were eroded or invaded. The cases of Syme and Cappell, Cappell, André-Thomas and Villandré, Owen, Hershey and

Gurdjian, Joyce and Chiari were typical examples. Two of these (Chiari and Cappell) showed an associated ecchordosis sphenoccipitalis.

In addition to the tumors which arose along the course of the notochord there were several chordomas which were found in atypical situations. Koritzki described small, submucosal chordomas which were attached to the alveolar processes of the superior and inferior maxillae of an infant aged 1½ months. Rubaschow reported an instance of a pedunculate chordoma which was suspended from the middle third of the alveolar margin of the superior maxilla of an infant who was 1 day old. Hirsch (1931) described a tumor which arose in the tonsillar region. Alezais and Peyron (1914) found a typical chordoma in the left superior occipital region.

From the preceding description it may be apparent that the strict classification of chordomas on the basis of their probable anatomic site of origin was beset with difficulties. For instance, various tumors which were described as primary nasopharyngeal chordomas were divisible into at least three groups: one in which the tumor was associated with a cranial neoplasm, another in which there was involvement of the cervical vertebrae, and a third group in which the cervical vertebrae and cranium, at the time of the report, were apparently free from tumor. A similar difficulty was encountered in the classification of cervical chordomas because several, which were considered as primary vertebral tumors, were associated with tumors of the clivus or nasopharynx or both. The final segregation of questionable cases as a rule depended on the postmortem observations, and these were not always conclusive.

#### HISTOLOGY

The histology of the usual chordoma was a partial reduplication of the morphology of the chorda dorsalis during its various stages of evolution. Three phases in the development of the chorda have been defined (Alezais and Peyron, 1922). At an early stage it is a hollow tube lined by cells of entodermal origin. Then the tube is transformed to a solid cord of closely approximated, polyhedral epithelial cells. Finally, as the structure is adapted to a supporting rôle the cells become vacuolated, and presumably elaborate a mucinous material which escapes into the intercellular spaces. As differentiation progresses the cells undergo variable morphologic changes, and become widely dispersed in a voluminous mucinous matrix.

The three stages, particularly the last two, served as an interesting basis for comparison with the variable histology of the chordomas. In only one tumor was there an architecture which resembled the primitive tubal structure of the chorda (Alezais and Peyron). A reduplica-

tion of the second stage was more common. In these instances the chordoma was composed almost exclusively of a mosaic of lightly acidophilic, nonvacuolated, round or polyhedral epithelial cells separated by a small amount of homogeneous intercellular material. The majority of the typical tumors exhibited the sequences of evolution through the second and third stages. In these neoplasms were columns and clusters of epithelial cells which seemed to serve as germinal centers about which there were less cellular fields in which progressive differentiation to an adult type of chordal tissue had taken place. These germinal centers usually were near the periphery of the lobulations, while centrally a mucinous matrix comprised almost the whole of the structure.

The histologic details of chordal evolution, as exemplified in the majority of the neoplasms, were singular. In the primitive polyhedral cells small vacuoles appeared. These were usually within the cytoplasm and rarely in nuclei. They were either single or multiple, and as they increased in size the cytoplasmic membranes were distended, and nuclei were displaced, as a rule, toward the periphery. Thus the typical physaliphorous cells were formed. The content of the nuclear vacuoles has not been identified (Stewart). The cytoplasmic vacuoles contained either an unstainable material, glycogen, or a mucinous substance. Presumably the mucin was a specific cell product. As evolution progressed it accumulated not only within cells but also in the intercellular spaces until finally there was atrophy and in many areas a disappearance of cells, so that only the mucinous matrix remained. At this stage the final phase of chordal evolution was reached.

The stroma of the connective tissue was almost invariably delicate. It supported a few well formed blood vessels. Parenchymatous hemorrhages, foci of necrosis and areas of cystic degeneration were not uncommon. Lacunar absorption of bone with reactive osteogenesis was noted in several instances.

This group of tumors, like all neoplasms originating in embryonic rests, in several instances showed certain variations and atypical features. There were gradations between the very cellular invasive tumors with numerous mitoses and the slow-growing or static tumors composed almost wholly of mucinous, intercellular material. In addition, polymorphism of cells, which was more often noted in the more malignant tumors, frequently was indicative of a neoplasm of possible sarcomatous or teratomatous nature. This question arose in several instances in which bone and cartilage were found in the midst of tumor tissue. The presence of these mesenchymal derivatives could not always be accepted as an incidental finding secondary to the displacement of periosteum or sequestration of osseous or chondrous fragments by proliferating chordal tissue. Although these elements usually were encountered near the bases of tumors where there was contact with bone, osteoblastic or

chondrogenic activity in the more distant parts of occasional tumors offered evidence that mesenchymal tissues had been displaced together with chordal tissue so as to form an active, fundamental and integral part of the growth.

#### SYMPTOMATOLOGY

The symptoms, as may be surmised from the anatomic variations of the tumors, followed no well ordered rule. In the chordomas of the clivus the first common symptoms, which usually were gradual in onset, were, in the order of their frequency: headache, visual disturbances, difficulty in breathing through the nose and pain in the neck. The headaches were of increasing severity, with temporary periods of relief in several instances. They were referred as a rule to either the frontal or the occipital region in accordance with the position of the tumor. The visual disturbances generally were the result of compression of the optic chiasm or the sixth nerve. In the former instance reduction of visual acuity and bitemporal hemianopia were the most important findings, which almost without exception prompted a diagnosis of a primary tumor of the hypophysis or its anlage. In the latter instance the resultant diplopia or blurring of vision not infrequently preceded headache as the first symptom of the neoplasm. The nasopharyngeal symptoms, although they usually accompanied or followed the onset of headaches and visual disturbances, occasionally were the first evidence of the disease. As a result of the obstruction of the nasopharyngeal passages by the tumor, difficulty in nasal breathing, nasal voice and mucoid discharge from the nose developed. Occasionally these complaints preceded the onset of intracranial symptoms for many years, the longest duration having been twelve years (Arauz and Podestà). Pain in the back of the neck, although usually late in onset, was one of the first complaints of four patients. This was generally suboccipital or paravertebral, and was initiated or accentuated by movements of the head. In several cases there were other early symptoms too numerous to mention in detail. Among these, vomiting, especially on rising in the morning, paresis of the seventh nerve and sensory disturbance in the fields of distribution of the trigeminal nerve were most frequent.

In the later stages the majority of the tumors were separable into three ill-defined groups in which there was selective impairment of cranial nerves. The first group was characterized by manifestations referable to the nerves anterior to the acoustic nerve. The second group usually involved the abducens and less frequently the facial and trigeminal nerves. The third group involved various nerves from the trigeminal to the hypoglossal, and compressed the brain stem or spinal cord in such a way as to produce sensory disturbances and symptoms referable to the pyramidal tracts.

Although the typical tumors were in the midline beneath the pons there was a pronounced tendency for involvement of the cranial nerves to be unilateral. When the impairment was bilateral, invariably it was more complete and more widespread on one side than on the other. Also paralysis of the left nerves was more common than that of the right, especially when the tumors extended anterior to the spheno-occipital synchondrosis. Therefore, as the tumor displaced the brain stem upward there was a tendency for the pons and medulla to be shifted to the right of the median line.

The impairment of function of the cranial nerves was the most valuable aid in the localization of the intracranial tumors. The olfactory nerve was spared in all except two cases, because tumors rarely extended into the anterior cerebral fossa. In many instances the optic nerve was involved either by tumors of the clivus which had extended anteriorly or by tumors which arose in the sphenoid bone. In nine cases there was choking of the optic disks, while three patients had primary optic atrophy. Various defects in the visual fields simulated those which are commonly produced by primary hypophyseal tumors, and the most important point in the differential diagnosis was the lack of evidence of a functional disturbance of the hypophysis. The ocular nerves frequently were involved. Blurring of vision, diplopia, internal strabismus, altered pupillary reactions, dilatation of the pupils, anisocoria and partial or complete ophthalmoplegia were a few of the various manifestations. Paresis of the abducens nerve (eighteen cases) was most frequent, and it usually preceded the onset of paralysis of other ocular nerves. The paresis in the late stages of the disease often was bilateral (nine cases), although there was a tendency for only the left sixth nerve to be involved. This was especially true in the early stages, although often there was a subsequent impairment of the right abducens. Also, there was a similar preponderance of paralysis of the third and fourth nerves on the left side, with bilateral involvement as a less common occurrence. Symptoms which arose from compression of the trigeminal nerve (nine cases) were less frequent than those due to involvement of the ocular nerves. Impairment of the motor function was rare, while various sensory disturbances, as frequently unilateral as bilateral, were recorded. In almost every instance in which the function of the facial nerve was disturbed (thirteen cases) the sixth nerve and, less commonly, the fifth nerve were involved. Bilateral and unilateral manifestations such as alterations in reflexes and twitching or paralysis of facial muscles were of about equal frequency. Compression of the auditory nerves, either within the skull or by tumor which pressed into the internal auditory canal through the porus acusticus internus, caused tinnitus, reduced auditory acuity or deafness in eight patients. In these instances symptoms were more commonly bilateral than unilateral. Whenever there



was a disturbance in taste in the area supplied by the glossopharyngeal nerve (six cases) there was evidence of involvement of the tenth, eleventh or twelfth cranial nerves. Unilateral or bilateral paresis of the vocal cords was attributed in six instances to impairment of the function of the vagus nerves. Four patients showed atrophy and paralysis of the trapezius muscles as a result of involvement of the eleventh nerve. More frequently (ten cases) the twelfth nerve was involved. Impairment of action and atrophy of the intrinsic lingual muscles with or without fibrillary twitchings were the usual findings. The atrophy frequently was unilateral and almost invariably greater on one side than the other.

Second in importance to the symptoms referable to the cranial nerves were the manifestations which followed compression of the brain stem and, in occasional instances, pressure against the spinal cord in the region of the foramen magnum. There were numerous symptoms which were, as a rule, secondary to involvement of the pyramidal or sensory tracts. Hemiparesis, which was on the left side in all but one of the seven instances in which it was present, was the most important symptom. Paraplegia, increased reflexes, muscular atrophy, clonic convulsions, incontinence, hypalgesia, hemianesthesia, hypesthesia, ataxia and loss of deep reflexes were other infrequent manifestations.

Among the remaining symptoms pain in the neck was emphasized by various authors. This usually was prominent only in the tumors which pressed through the foramen magnum. The pain was accentuated by motion of the head and occasionally was so severe that the patient was obliged to hold his head rigidly in a fixed position. Cerebellar symptoms were rare (five instances). Sensory aphasia and agraphia due to involvement of the cerebrum were noted in one instance (Kotzareff). The late symptoms which preceded death usually were apathy and somnolence followed by bulbar symptoms and coma.

A detailed enumeration of the symptomatology of the so-called hypophyseal, dental and nasopharyngeal chordomas would be nothing more than a recapitulation of the symptoms of certain chordomas of the clivus, because the anatomic situation governed the clinical manifestations. The rare chordomas which presumably arose from the anterior extremity of the notochord produced symptoms which were largely the result of compression of the optic chiasm and the ocular nerves. The dental chordomas, which were considered as arising from the region of the dens epistrophei, were a combination of tumors of the clivus and nasopharyngeal or cervical tumors, and gave corresponding variable symptoms. The nasopharyngeal tumors usually were also complicated by neurologic manifestations. The relationship between the obstructing nasopharyngeal growths, the cervical chordomas and the cranial tumors has been emphasized. However, there were several tumors which were



characterized by the lack of evidence of an associated neoplasm of the clivus or vertebrae (Grossmann, Fabricius-Möller, Hirsch, Citelli, Argaud and Clermont and Pavlica). Two instances (Grossmann and Pavlica) were accepted with reservations because there was evidence of partial destruction of bone at the base of the skull. All six patients were living at the time the reports were made. The longest period of observation was about five years (Fabricius-Möller). The subsequent courses of these patients will be of considerable interest. At a later date tumor may be found in the basilar process of the occipital bone and on the clivus or involving the vertebrae.

The chordomas of the cervical region occasionally were associated with tumors of the clivus or nasopharynx, but in several instances the evidence favored origin from the cervical vertebrae or intervertebral disks. The common early symptom was pain in the neck and arms. The progression of the disease usually was characterized by the development of symptoms referable to compression of the spinal cord and nerves in the midcervical region (Cappell, André-Thomas and Villandrè, Chiari, Owen, Hershey and Gurdjian and Joyce). No symptoms were recorded by Klebs. In one patient (Trélat) the tumor extended laterally, and although there was pain in the right arm, the spinal cord apparently was not involved. In another instance (Syme and Cappell) the growth extended anterior to the vertebrae and partially obstructed the pharynx so that there was difficulty in swallowing and in breathing.

#### DIFFERENTIAL DIAGNOSIS

It must be admitted that the clinical diagnosis is difficult without the aid of roentgen examination or biopsy. However, in certain cases, a proper analysis of the signs and symptoms should lead to a surprisingly large number of accurate diagnoses. In recapitulation, the salient clinical features may be summarized as follows: a gradual onset of nasopharyngeal and neurologic symptoms in middle-aged patients; the presence of an obstructing, midline, nasopharyngeal tumor; progressive, bilateral palsies of the cranial nerves, which may be quite widespread with little or no evidence of intracranial hypertension; sensory as well as motor manifestations, and symptoms arising from compression of the brain stem or the upper cervical portion of the spinal cord.

To supplement the clinical picture there may be important roentgen indications, usually of a destructive, nonproductive lesion of bone. This is found, as a rule, in the midline of the base of the skull from the sphenoid bone to the foramen magnum. It may be localized or diffuse. Less frequently there may be partial destruction of the dens epistrophei, arch of the atlas and various vertebral bodies, even though the base of the skull is normal. It may be possible to visualize a smooth, rounded,

soft tissue mass bulging beneath the posterior nasopharyngeal wall. Perhaps scattered opaque clumps of displaced bone may aid in localization of a tumor above the hypophyseal fossa or clivus. Of greatest value in selected cases may be the injection of iodized poppy-seed oil 40 per cent into the subarachnoid space in order to demonstrate the presence of an extradural tumor compressing the ventral surface of the cervical cord.

If the errors of diagnosis which have been made are not to be repeated, it would seem wise to enumerate the common mistakes and to dwell briefly on a few of the more important points of differential diagnosis. There are many good reasons for confusing a chordoma with a craniopharyngioma (tumor of Rathke's pouch) or a tumor of the hypophysis. The manifestations referable to the cranial nerves, especially the defects in the visual fields and the roentgenographic changes may be identical. There may even be suprasellar calcification, such as is common in a craniopharyngioma. The adenomas and carcinomas of the hypophysis may destroy a considerable amount of bone, and in order to complete the imitation of a chordoma they may grow into the nasopharynx. Therefore, one usual point of difference between the anterior group of chordomas and the hypophyseal tumors deserves emphasis. In the former there is little or no evidence of hypophyseal dysfunction. As craniopharyngiomas usually occur in children, chordomas are less frequently confused with these tumors. Parasellar meningiomas, although they rarely extend into the nasopharynx, should be considered in the differential diagnosis.

Infratentorial tumors may closely simulate chordomas which arise from the clivus. Among these, pontile gliomas, meningiomas, neurinomas of the acoustic nerve and rare dermoid cysts are most important. With these neoplasms the symptoms are usually unilateral, and the bony changes which sometimes occur are neither of the type nor in the position of those produced by chordomas. Furthermore, a widespread bilateral impairment of cranial nerves without intracranial hypertension would be rare among this group of tumors of the posterior fossa.

Chordomas which involved the nasopharyngeal passages almost invariably were overlooked or were considered as one of the more common nasopharyngeal tumors. The rare juvenile nasopharyngeal fibroma may arise in the same situations and may grow in much the same manner as a chordoma. It may extend into the cranial cavity and cause various neurologic symptoms. However, these tumors develop before the twenty-fifth year. There is a tendency for the tumor to disappear spontaneously, chiefly toward the end of the second decade of life. Atypical chondromas, chondrosarcomas and myxosarcomas in this region may offer greater diagnostic difficulties not only to the clinician but also to the roentgenologist and pathologist. Other local tumors such

as pharyngeal dermoid cysts and teratomas usually occur in infants and children. Although a primary carcinoma of the nasopharynx may invade the base of the skull and involve the cranial nerves, metastases are almost invariably found in the cervical lymph glands.

If there are symptoms referable to the spinal cord the extradural mass which principally compresses the ventral surface of the cord may be outlined by the injection of iodized poppy-seed oil 40 per cent into the cisternal or spinal subarachnoid space. As there is usually lacunar destruction of the bone adjacent to the spinal tumor one is able ordinarily to exclude the common primary tumors of the meninges, spinal cord and nerve roots. It may be much more difficult to distinguish certain chordomas from tuberculosis of the upper cervical portion of the spine, especially when pain in the neck and rigidity of the spine are the presenting symptoms. Furthermore, in the latter there may be an associated retropharyngeal mass, symptoms referable to the spinal cord and nerve roots and evidence of destruction of bone. This combination presents a formidable problem which may defy solution. Metastatic carcinoma in vertebral bodies with growth into the spinal canal may be excluded by evidences of the neoplasm elsewhere. Other tumors of this region, such as angiomas and sarcomas of the vertebrae, usually can be recognized by the roentgenologist.

Various neurologic conditions, especially progressive bulbar paralysis, amyotrophic lateral sclerosis, syphilis of the central nervous system and cerebral vascular lesions, may be considered with brevity. In progressive bulbar paralysis there are no sensory disturbances, the oculomotor nerves are rarely involved, dysarthria is usually an early symptom and there is never intracranial hypertension. Amyotrophic lateral sclerosis may simulate the clinical picture of certain cervical chordomas. An important point in the differential diagnosis is pain. Pain in the neck or arms is almost invariably an early symptom of chordomas. Syphilis of the central nervous system, with its many manifestations, may be excluded by the usual tests. The symptoms due to cerebral vascular lesions which cause the syndrome known as pseudobulbar paralysis usually are sudden in onset and tend to occur in older age groups than chordomas do. In the final analysis the errors in diagnosis, as a rule, may be attributed to an insufficient knowledge of the characteristics of these rare tumors rather than to difficulties in the differential diagnosis.

#### PROGNOSIS AND TREATMENT

Chordomas almost invariably proved fatal in all instances in which the patients were under observation for a long period.

The average duration of life of patients who had involvement of cranial nerves was about three years from the time of onset of the first

symptoms. Long histories were obtained in several instances: eighteen years (case 1, Bailey and Bagdasar), twelve years (Lemke and Arauz and Podestà) and seven years (Filippini). A rapid course of from eight to twelve months was not unusual.

The prognosis of cervical chordomas also was bad. In three fatal cases (Syme and Cappell, Cappell and Chiari) the duration of symptoms was eight months, ten months and eighteen months, respectively.

The prognosis of so-called nasopharyngeal tumors was variable, depending largely on the presence or absence of cerebral involvement or involvement of the spinal cord. One patient was under observation for a long period (Fabricius-Möller). He had a history of difficulty in breathing through his nose for seven years. A tumor projecting from the posterior wall of the nasopharynx was removed. It recurred a few months later. A second operation was performed four and a half years after the first. Five months later the patient was well. In a similar instance (Klotz) the patient returned with a recurrence four and a half years later.

Surgical removal offered hope in certain selected cases, but recurrence without metastasis was the rule. In twenty-five instances an attempt was made to remove the tumor. Among those who survived there were few who were benefited. Follow-up studies often were not available, but as a rule the tumors recurred within from six to eighteen months. The best results over a long period of time were those just mentioned (Möller and Klotz). Improvement without recurrence over a period of eighteen months was an exceptionally good result following removal of a cervical chordoma which compressed the spinal cord (André-Thomas and Villandré). The remaining patients reported as improved were not observed for a sufficient length of time to warrant detailed consideration. Therefore it seemed that operation, as a rule, offered only temporary amelioration of symptoms and in some cases even stimulated the tumors to more rapid growth (Pavlica). Yet it is possible that pedunculate, encapsulated, noninvasive tumors may be completely eradicated by excision.

Supplementary roentgen and radium treatment was of no established benefit. Herrmann noted a reduction in the size of the tumor following roentgen treatments, but there was a recurrence which proved fatal. A combination of roentgen and thorium therapy was thought to be of value in one instance (Goerke). In the other cases the authors usually admitted the ineffectiveness of irradiation.

Because it is unwise to regard all chordomas as hopeless from the standpoint of therapy, it seems worth while to record the progress of a patient (Bailey and Bagdasar, case 1) whose condition was improved for a long period after partial extirpation of a chordoma which compressed the optic chiasm. The tumor was removed by Dr. Harvey

Cushing in 1928. For about three years after the operation the patient's visual acuity was improved, and she had no untoward symptoms. During 1931 and 1932 her visual acuity gradually diminished. In November, 1932, there were total blindness in the left eye, temporal hemianopia in the right eye, paralysis of each external rectus muscle and headaches. In June, 1933, five and a half years after operation, the vision of the right eye was greatly reduced and paralysis of the pharyngeal muscles was developing. Dr. C. G. Dyke of the New York Neurological Institute submitted to Dr. M. C. Sosman roentgenograms taken on Dec. 31, 1932, for comparison with the preoperative roentgenograms of Jan. 5, 1928. Dr. Sosman gave the following report:

The films of Jan. 5, 1928, show definite atrophy of the posterior clinoids. There is an irregular defect in the basisphenoid just below the posterior clinoids at about the spheno-occipital synchondrosis.

The films of Dec. 31, 1932, show considerable enlargement of the pituitary fossa with peculiar irregular bone formation projecting upward and backward from the remains of the posterior clinoids. The basisphenoid is soft and mottled in appearance and is apparently invaded by tumor although the ventral surface is still intact (fig. 1).

#### REPORT OF CASE

*History.*—A. W. P., a broker and polo player, aged 59, entered the hospital on Nov. 26, 1932, complaining of difficulty in speaking and swallowing and of progressive weakness of fifteen months' duration. Nine years before he was momentarily stunned by a blow on the vertex of his skull. Until August, 1931, he had enjoyed good health. At that time he was seized with a severe occipital headache which radiated toward the vertex. Following this he experienced slight difficulty in speaking and swallowing. The positive physical findings were paralysis and slight atrophy of the intrinsic muscles of the tongue. The spinal fluid was under increased pressure. It contained 1 cell per cubic millimeter, and the globulin and sugar estimations were normal. A roentgenogram of the cervical vertebrae showed a slight posterior displacement of the occiput on the first cervical vertebra.

Gradually a generalized weakness developed. By January, 1932, he was unable to work. In June, 1932, he first noticed diplopia and an internal strabismus of his left eye. The difficulty in articulation and swallowing increased in severity. He was unsteady on his feet and occasionally fell. In August, 1932, he began to have attacks of projectile vomiting. These attacks occurred at intervals of about four days. They were neither preceded by nausea nor restricted to any particular period of the day. In October, 1932, when he attempted to swallow fluid it was regurgitated through his nose. Headaches continued and attacks of vomiting came with greater frequency. Because he was unable to take or to retain much nourishment, he lost 48 pounds (21.8 Kg.).

*Physical Examination.*—The patient was well developed but emaciated. There was slight asymmetry of the skull, the right parietal region being more prominent than the left. There was no disturbance of olfactory sensation. The pupils were equal and regular. They reacted normally to light and in accommodation. Left internal strabismus, diplopia and nystagmus on both horizontal and vertical motion were noted. Visual acuity was not diminished. The margin of each optic disk was blurred. The sensation of the cornea of each eye was diminished. The sensation



of taste was reduced over the surface of the tongue. There was no facial paralysis. Auditory acuity on the left was less than on the right. The gag reflex was absent. The voice was husky and phonation was difficult. Generalized atrophy and weakness of skeletal muscles were observed. The trapezius muscles were not unduly affected. It required considerable effort for him to protrude his tongue. The tongue deviated to the right, and the left half was much more atrophic than the right. There were no fibrillary twitchings. The abdominal and cremasteric reflexes were absent. The knee jerks were sluggish and the ankle jerks absent. The plantar response was flexion.

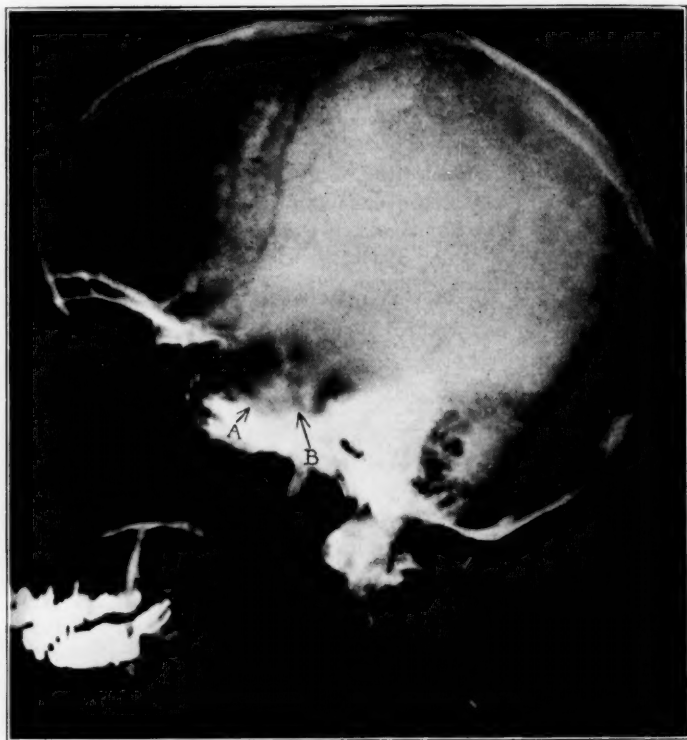


Fig. 1.—A roentgenogram of the cranium and cervical portion of the spine five years after operation in case 1 reported by Bailey and Bagdasar; before operation the osseous changes were scarcely detectable. The arrow (*A*) is directed toward the floor of the expanded hypophyseal fossa and (*B*) toward the clivus. Both areas show the destruction of bone. Compare this film with that of figure 2.

On admission the temperature was 102 F.; the pulse rate, 90, and the respiratory rate 20. Studies of the blood and urine gave negative results.

*Course.*—Feeding by gavage was necessary because of the difficulty in swallowing. A roentgenogram of the skull was taken. The report as given by Dr. M. C. Sosman, who studied the roentgenograms after the death of the patient, was as follows: "The skull films of Nov. 26, 1932, show a cleancut destructive process involving the occipital bone at the anterior edge of the foramen magnum just above



the odontoid process. The arch of the atlas is also partly destroyed and there is a large soft tissue tumor bulging into the posterior nasopharynx. There is no new bone reaction or other signs of inflammatory disease. Impression: Findings indicate a malignant process, possibly metastatic. The only primary one in this area would be a chordoma" (fig. 2).

On Dec. 1, 1932, a lumbar puncture yielded clear fluid under an initial pressure of 140 mm. of water. With compression of the right jugular vein the pressure rose slowly to 145 mm., and on release, fell gradually to 140 mm. With compression on the left jugular vein there was a slow rise to 165 mm. and on release a slow fall



Fig. 2.—A roentgenogram of the cranium and cervical portion of the spine of the author's case of sphenoccipital chordoma. The arrows are directed: (A) toward the irregular ventral surface of the basilar process of the occipital bone; (B) toward the apex of the dens epistrophei; (C) toward the anterior arch of the axis, and (D) and (E) toward the soft tissue shadow in the nasopharynx. Note the destruction of bone at A, B, and C. Compare with the corresponding normal areas of figure 1.

to 140 mm. Compression of both jugular veins resulted in a rapid rise to 170 mm. Examination of the spinal fluid revealed 22 red blood cells, 1 lymphocyte, a total protein value of 10 mg. per hundred cubic centimeters and a positive globulin reaction (Pandy and ammonium sulphate tests).

On December 29, the patient complained of vertigo, impaired hearing by the left ear and soreness of the left side of the neck. Subsequent to aspiration of food

there was an elevation of temperature, pulse rate and respiratory rate. On January 7 he was suddenly seized with a clonic convulsion which involved the right side of the body. He died fifty-five minutes later.

*Autopsy.*—*Diagnosis:* The anatomic diagnoses were: malignant chordoma (spheno-occipital); atrophy of the tongue; internal strabismus (left); atrophy of the skeletal musculature; emaciation; foreign material in the lungs; bronchopneumonia; frontal sinusitis; congenital anomaly of the left vertebral artery; arteriosclerosis (generalized); adenomas of the thyroid gland; tuberculosis of the lungs (apical, healed); miliary tuberculosis of the lungs, liver, spleen and lymph nodes and asymmetry of the skull.

*Gross Examination:* As the examination of the head and neck was of greatest importance, the other anatomic findings may be considered with brevity. The atrophy of the intrinsic musculature of the tongue was pronounced, being greater on the left than on the right. The internal strabismus of the left eye was noted during life. The atrophy of the skeletal musculature was fairly uniform, and no exceptional involvement of the trapezius and sternocleidomastoid muscles was recorded. Numerous particles of food and other foreign material were found in the respiratory passages and alveolar spaces. The related foreign body reaction and more recent lobular pneumonia completed the picture of bronchopneumonia of the aspiration type. Although the apical pulmonary tuberculosis was apparently healed, a few miliary tubercles were found in the lungs, liver, spleen and lymph nodes. The bilateral frontal sinusitis was more severe on the right than on the left side. The left vertebral artery arose from the arch of the aorta between the left common carotid and left subclavian arteries. The thyroid gland, which weighed 45 Gm., contained several colloid adenomas. There was slight asymmetry of the skull.

During removal of the brain an extradural tumor which projected upward from the floor of the posterior fossa anterior to the foramen magnum was disclosed (fig. 3). The tumor was moundlike, purplish gray, fairly firm and slightly nodular. Although it was situated almost exactly in the midline of the basilar process of the occipital bone there was a greater expansion to the left than to the right. Its breadth (4 cm.) and elevation (2 cm.) were greatest just posterior to the level of the pori acustici and gradually diminished posteriorly as the tumor disappeared in the vertebral canal anterior to the spinal cord. The anterior margin of the neoplasm encroached on Durella's canal on the left. The left porus acusticus internus, jugular foramen and hypoglossal foramen were obscured by the broad base of the tumor. The base of the brain stem and cerebellum as well as the ventral aspect of the spinal cord were not adherent to the dura overlying the tumor, but their usual structure was compressed and distorted so as to conform to the contour of the extradural mass (fig. 4). As a result the usual courses of the cranial nerves arising from the brain stem were altered. The sixth to twelfth nerves on the left and the twelfth on the right were more seriously compromised because they pierced the dura overlying the tumor and for variable distances were in contact with or were embedded in the substance of the tumor (fig. 3).

The osseous extensions of the neoplasm were restricted largely to bone lying directly beneath the tumor. The sella turcica and the body of the sphenoid bone were intact. The posteromedial portions of the great wings of the sphenoid, the apexes of the petrous portion of each temporal bone, almost all the basilar process of the occipital bone anterior to the foramen magnum, the anterior arch of the atlas, the dens epistrophei and the body of the second cervical vertebra were partially destroyed by lacunar excavation.

The basilar process of the occipital bone did not limit the growth of the tumor ventrally. The neoplastic tissue beneath the dura on the clivus was directly continuous with the tumor which expanded the space bounded normally by the inferior surface of the basilar process as far forward as the spheno-occipital synchondrosis, by the apical odontoid ligament and by the dens epistrophei, the anterior arch of the atlas, the upper portion of the body of the axis and the musculature of the

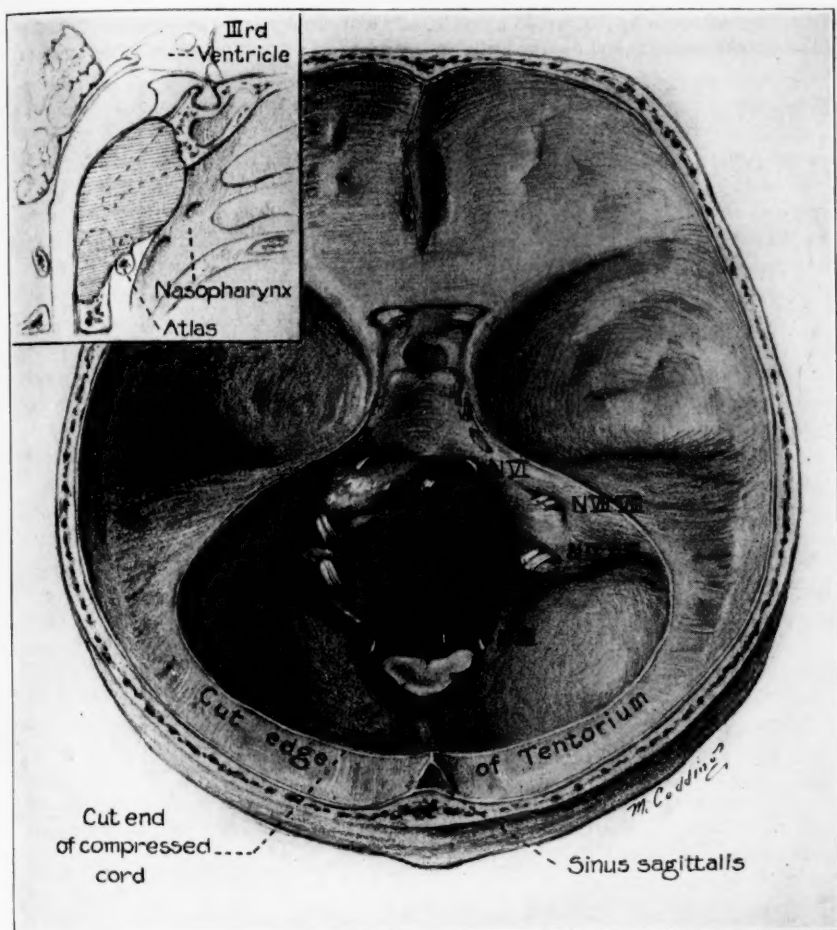


Fig. 3.—The sphenoid-occipital chordoma as it appeared after removal of the brain. The insert illustrates a midsagittal section through the tumor in situ.

epipharyngeal wall (figs. 2 and 3). Although the pharyngeal wall was displaced anteriorly the musculature and mucosa were not invaded by the tumor.

The neoplasm was composed of soft grayish-pink material of gelatinous or mucinous character. Between these soft masses of tissue were numerous fragments of sequestered bone, much of which was soft and necrotic. There were many spaces hollowed out of the bone limiting the margins of the growth. These,

too, contained soft tumor tissue which in most instances was separated from the bone by a layer of thick fibrous tissue which was continuous with delicate connective tissue septums that traversed the tumor in many directions. There was no widespread invasion of soft tissues, and no tumor was found in either blood vessels or lymph nodes.

**Histologic Examination:** After fixation in Zenker's solution blocks of tissue for microscopic study were selected from the epipharyngeal wall, the dura overlying the neoplasm and tumor tissue above the basilar process of the occipital bone, in the basilar process and in the dens epistrophei. The sections were stained with

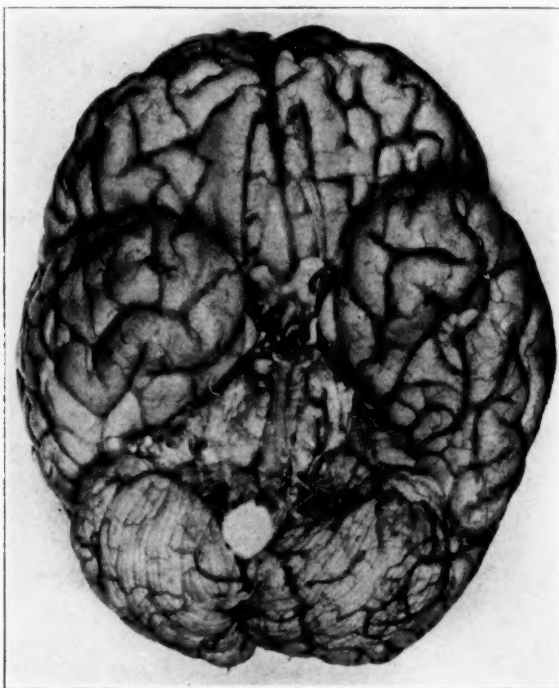


Fig. 4.—A photograph of the ventral surface of the brain in the reported case of sphenoccipital chordoma. Note the effects of compression of the brain stem and cerebellum, especially on the left side.

eosin-methylene blue, phosphotungstic acid-hematoxylin and aniline blue. Mucin and hemosiderin were demonstrated by appropriate methods.

A salient histologic feature was the limitation of the neoplasm by neighboring soft tissues. There was no invasion of lymphatic or vascular channels. The dura which separated the tumor from the brain stem and spinal cord was infiltrated in its outermost layers by scattered tumor cells. Although the basilar process in the midsagittal plane was extensively destroyed, the lateral spread of the tumor was partially prevented by dense connective tissue which was interposed between the expanding tumor and the osseous walls of many lacunar spaces. In the epipharynx dense connective tissue again served as a barrier and protected the pharyngeal musculature and mucosa from invasion.

The architecture of the extra-osseous growth was somewhat different from that which occurred in bone. The former was composed of irregular lobules separated by collagenous septums which were continuous with the dura or connective tissue capsule at the periphery of the neoplasm. The lobules principally were composed of a mucinous material in which clusters of tumor cells were embedded. Cellularity was greatest adjacent to the septums of connective tissue, and diminished centrally in those areas in which mucin was most abundant. The rather uniform structure was interrupted not only by areas of old and recent hemorrhage with accompanying deposits of hemosiderin but also by islands of sequestered and new-formed bone. The osseous elements were found just beneath the dura as well as in the neighborhood of the basilar process. The few blood vessels which were encountered had thin walls and were largely restricted to the areas of connective tissue stroma. The architectural detail of the extra-osseous portions of the tumor previously described was altered wherever there was invasion of bone. Here the neoplasm extended by way of the medullary space. It not only induced lacunar resorption and atrophy of bone by pressure and sequestration but also stimulated an indolent formation of new bone. The apparent continuity of the substance of the tumor with the osteoid matrix was frequently observed and tumor cells were often embedded in the osteoid tissue. Also, certain areas were almost indistinguishable from cartilage. Other features which characterized the neoplasm in bone were a diminution in the vascularity, an almost complete absence of connective tissue stroma and a predominance of mature physaliphorous cells.

The cytology was that of a typical chordoma, which must have grown slowly. The cells were arranged in clusters, in columns and singly. They were polymorphic and varied greatly in size. When they were grouped in syncytial masses, they were usually small and polyhedral. When in columns, they were frequently fusiform or goblet-shaped cells. When isolated in small clusters or as single cells, they generally were large, swollen and vacuolate. Stellate and small fusiform cells were usually scattered in the voluminous portions of the matrix. The nuclei were from small to medium-sized. Occasionally two were found in a single cell. As a rule they were elliptic and were limited by an irregular nuclear membrane. The nucleoli were prominent. There were no nuclear vacuoles or mitotic figures. The cytoplasmic contents were characteristically homogeneous or slightly granular and lightly acidophilic. Small to large vacuoles, either single or multiple, often replaced large portions of the cytoplasm, distended the cells and displaced the nuclei. The vacuoles usually were empty, but occasionally they contained a mucinous substance. The intercellular mucinous matrix comprised the major portion of the tumor. It was of homogeneous or fibrillar appearance, the latter being due principally to artefact.

#### COMMENT

This case is an example of a diffuse type of a spheno-occipital chordoma which produced clinical symptoms because of involvement, principally by direct pressure, of various cranial nerves and the brain stem. The forward bulging of the epipharyngeal wall and the destruction of the basilar process of the occipital bone, the anterior arch of the atlas and the tip of the dens epistrophei (as shown in the roentgenograms) were fairly characteristic of a malignant chordoma. Autopsy disclosed a tumor of relatively slow growth in approximately the position illustrated in figure 3. The asymmetry of the skull and the anomalous

vertebral artery lend strength to the theory that chordomas rise from rests of notochordal tissue displaced during the period of embryonic development.

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## DEPRESSIONS WITH TENSION

THEIR RELATION TO THE GENERAL PROBLEM OF TENSION

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In the practical handling of a psychiatric problem, one does not treat only for disease entities, such as depression or schizophrenia, but rather for reactions that constitute more or less characteristic samples of what is wrong or not working well. The treatment in the sample or phase escapes being a rule of thumb procedure by a consideration of the likelihood of more far-reaching range involved in the illness, of which the former are only incidents. For example, treatment for insomnia could in most cases be a routine procedure did not the necessity for considering the reaction-set in which it occurs demand certain precautions, impose certain restrictions and offer special light.

In the past few years, there have been observed in the Henry Phipps Psychiatric Clinic of the Johns Hopkins Hospital a group of patients with depressive reactions of such character as to demarcate themselves sharply from the general body of affective reactions. The conclusion is that this difference rests on the presence of tension as a leading and characteristic feature, the result of personality difficulty, in a depressive setting. This article will limit itself largely to a consideration of this group of depressive reactions and of the problem of tension, the clinical means for its detection, its spontaneous evolution and methods for its control. The subject is too relative to be dealt with categorically, but there are already some well established facts.

### WHAT IS TENSION AND HOW DOES IT APPEAR CLINICALLY?

It is not easy to define tension in such terms as always to identify it. One must begin with what the patient presents at the successive integrative levels, and so arrive at a grouping or syndrome which will afford a certain degree of familiarity with the state.

In general, the patient is aware of being tense, taut, under strain and unable to relax. This finds overt expression in characteristic statements of dissatisfaction, discontent and a special type of somatic complaints, in restless, impulsive behavior and often in a certain apprehensive, anxious attitude—a futile strenuosity without satisfaction and involving the whole body. The special physiologic manifestations belong in part

to the phenomena of autonomic imbalance, especially with evidence of sympathetic preponderance, and probably in part to localized changes of tonus in striped muscle. This vegetative dysfunction and change of tonus undoubtedly offer a basis for much of the aforementioned somatic complaining. With this general survey in mind one can proceed to a more detailed consideration in résumé of typical cases which provide the principle.

In this group are patients in the most productive and stable portion of their lives. Of the twenty-eight patients in the group, fifteen remained in the hospital long enough for accurate observation. Of these, two were in the third, eight in the fourth and three in the fifth decade of life; one was 55, and one, 63 (recurrent) years old. Nine of them were in their first attack of illness; four had had one, and one (aged 43) had had six previous attacks; all the attacks were alike, lasting from a few weeks to a year.

With only few exceptions the patients were admitted after an illness of from six months to two years or more. They had been under observation for from three to ten months longer. The two who recovered while still in the hospital had had illnesses of twenty-four and thirty months' duration. Durations of from one to three years are not unusual.

*Complaints.*—Typical complaints presented by the patients are: "Nerves like rubber bands and all aquiver; skin over forehead feels stretched; feelings of bubbles and needles in muscles; the privates draw and quiver; a feeling of worms in the scrotum, of worms crawling under the skin; shooting pains, numbness, trembling, burning, weakness, creeping and quivering sensation in stomach; scratching feeling in the neck; tension ache through the eyes; tightness in neck; restlessness; fatigue, nerves."

In addition, there are the complaints, rather common to all depressed patients, of insomnia, anorexia and loss of weight. The mood, rather strangely, may not be an outspoken subject of complaint. In reply to direct questioning statements as to the mood vary from "blue, low, grieved, worried; not so good; sad; not happy and not sad; depressed; I try to keep cheerful; depressed and no reason to be; frantic, have to give my spirits a kick to keep them up; at the end of everything" to "pretty good; I can't seem to get into a happy frame of mind; pretty good (equivocal tone of voice); not depressed."

In spite of the rather subordinate position of the complaint as to mood, these patients are uniformly observed by the nurses as sad, brooding and uninterested, and the behavior charts show a corresponding band of markings in the depressive zone. Eleven of the twenty-eight patients in this group admitted suicidal preoccupations; there were three suicidal attempts, two ending fatally. This subordination of the mood to the

somatic sensations in the patient's complaints is frequently misleading and causes an improper evaluation of the trouble as a merer gastric—i. e., part-reaction—rather than as a holergastic disorder. It is a serious error to fail to recognize depression and to consider the patient as psychoneurotic. It is common for the patient to feel "happy to be here," and to anticipate an early recovery. During the early days the depressive element may be entirely masked; it may become apparent only when expectations are unrealized.

*Content.*—The content is overwhelmingly of somatic complaints of a special sort, coupled with feelings of inward tension, a desire to escape from self, nervousness and concern, preoccupations and worry. The somatic complaints and the expression of the desire to escape from self and from a situation may be regarded as the overt content.

There is no difficulty in obtaining this type of statements and behavior. The patient is usually voluble, demands time and opportunity to reiterate his complaints and often gives the appearance of placing the physician in the position of having to furnish relief: "Here I am, and this is my trouble—now you do something about it." This attitude has usually led to such trouble with family, friends and private physician that all have at last combined to insist on hospitalization. It is of interest that the somatic complaints are such as to defy ordinary methods of examination. The constant complaining, coupled with an unusual lack of outward evidence of deep depression, brings about an especially trying situation with relatives, friends and the uninitiated physician.

One cannot escape the belief that such content is decidedly superficial. This follows from the strongly reactive character of the illness. It is true that the reactions are rather slow and to situations and life experiences progressively more intolerable; in some cases every conceivable alternative opportunity for relief seems equally unsatisfactory.

A few illustrations may indicate the general character of the situations.

CASE 1.—A man, aged 46, in a situation in which he was faced with the possibility of being unable to collect a debt of \$26,000 due him, became worried over this and experienced a fear of the pregnancy of his wife and of a young woman with whom he had been philandering. He wavered in his decision to give up the girl, although he thought that he should do so; she supplied him with the sex fervor he found lacking in his wife. In this situation of indecision and with future disaster a grave possibility, he began to have short periods of depression in which he was impotent; this increased his worry. He soon became markedly restless, chafing, uncertain and anxious, with shifting depression and tension in an endeavor to escape from a situation which was the result of his own apprehension and indecision.

CASE 2.—A man, aged 45, who had always been successful, rigid, stubborn and aggressively ethical, left a good job because he detected immorality among his superiors. There followed, in rapid succession, a number of jobs, each less suc-



cessful than the former, and he was bitter over being "fired" from two of them. This man's illness seemed to have developed from his rigidity and from his inability to choose correctly between the need for adjustment of personality and the meeting of certain external conditions as the basis for a better stabilization.

CASE 3.—A man, aged 33, a simple fellow, had always led a promiscuous sex life. At last he met a young girl he idealized. He never had sex arousal from her. She urged marriage; he procrastinated, but with the setting of the date for the marriage there developed gastro-intestinal hypochondriasis, which shifted to the genital region after a medical examination and the assurance that all he needed to get well was marriage. This man was confronted with the need for decision, either way offering certain allurements but also undoubted disadvantages. The depression with tension followed.

CASE 4.—A woman, aged 31, made the rather belated discovery that her husband, because of alcoholism and the financial insecurity he offered, did not meet the high expectations she had had at the time of marriage as the village belle. This together with the constant and alluring pressure of her family to bring about her return to the parental roof led to great strain, with self-depreciatory ideas for not being able to settle her affairs in a satisfactory way.

In over half of the cases, disturbance in the sexual sphere loomed large. In several cases there was homosexuality for the first time offering difficulty—in one patient, the necessity for a choice between her husband and a homosexual partner. In unmarried patients sexual arousal and in others the inability to face and deal adequately with it was the basic factor.

In other patients sexual factors seemed of little or no importance: A difficult situation at work, with suspicions in the atmosphere; dissatisfaction with the priesthood because of difficulty in accepting supervision, and because it prevented him from meeting a feeling of financial obligation to the family; a change in type of work after forty years at one job, and a feeling that the office assistant would not play fair in acquainting him with the details of the new work; inability to accept any but his own methods of conducting his business, methods which had been successful but were not acceptable to a new employer; loss of protection to his dependent personality through the death of two elderly aunts at a time when he had contracted some unusual debts in a business venture—all these served to furnish the setting in which tension and depression grew.

It is not without significance that in most of the cases the concern and tension are caused by still open events which have not spent their possibilities for future disaster. This contrasts with retarded simple depression, in which the concern is largely for past events. In this respect, this group of cases resembles the agitated depression of elderly patients with extreme worry over the future.

*Behavior in the Ward.*—The complaints of the patients and some of the etiologic factors have been discussed. What is the common diffi-

culty? From first to last, these patients insist on inflicting themselves on the environment. They feel that anything other than what is being done would be better for them; amid loud protestations of desire to cooperate they neglect no opportunity to take the management of the case into their own hands; they demand daily to leave the hospital, and in the next breath beg to be allowed to remain; or they have to be pushed out of the hospital, all the while insisting on the gravity of their illness.

Extracts from the nurses' notes are so uniform in tenor as vividly to characterize this type of patient and somehow to indicate the nursing difficulty. The patient's activity may be grouped roughly as follows:

1. General Tenseness and Restlessness:

Picks at sore spot on shoulder, at pimples, at teeth.

Bites lips; rubs face; rubs gums.

"All nerves in my arms and legs are singing like electric wires."

"I feel like jumping out of my skin."

"I feel like screaming."

"I wish I could drive that car! If he (chauffeur) would only go fast."

Restless, agitated, tense, jumpy.

Jumped up between games of bridge—"I have to take a walk."

"I wish you had something for me to do every minute."

Agitated when not distracted.

Unable to remain at anything any length of time.

"Can't sit still long enough to play bridge."

"I feel like a flea on a hot plate."

"If anyone says a cross word to me, I'll knock him on the bean."

"I'd like to see anyone tell me what to do when I leave here."

Tickle in throat at night, nervous cough.

Constantly relighting pipe, scratching head and running hand through hair.

Back rubbed at night.

"I cannot stop reading the newspapers—different from the way I used to be."

"I'll go crazy if these nerves in the back of my legs and arms don't stop singing."

"I just can't lie on that bed." (Rest hour.)

Wants to walk long distances, take violent exercise.

2. Feelings of Being Caught:

"I feel worse when I stay inside" (hospital).

"I am trapped here."

"Anything to get out of here."

"I am never going to tell when I have aches and pains—I will only have to stay here longer."

Talks of leaving all the time.

"I can't stand it here any longer."

"I feel like running and running."

"Let's go anywhere, just so it's outside the gate" (of the hospital).

"Something is going to happen if I'm kept locked up."

"I simply must do something to get out of this place."

"I'd like to get away from these sick people and into normal surroundings again for a few days."

## 3. Compensatory Mood Reactions:

Almost frivolous at times.

Sarcastic, abrupt manner with attendant.

"I want to go home!" Laughed when told to say something else.

Overbid hand at bridge; played recklessly.

Laughed and giggled: "I'm just laughing because I'm so tired."

"I wish I didn't feel so good in the mornings. I feel as if I could move mountains."

Cheerful, jovial, good spirits, congenial, hilarious (scattered throughout charts).

Smiling continually.

Laughs, talks loudly. Loud laughter, singing, cheerful.

Laughed heartily at vulgar joke (female patient—unlike her).

"Wouldn't it be fun if I got run over!" (Laughing and passing it off in a joking manner.)

## 4. Unreality (of Lesser Importance):

Feeling of no affection for family.

"This seems like a dream."

Several of the patients with marked depersonalization or feelings of unreality appeared "normal" in their dreams, and the waking state was "like a dream." One patient fought off sleep because of the disappointment always incurred on waking to find she was not "normal," as she had felt in her sleep.

## 5. Labile Mood and Ambitendency:

Laughed and giggled: "I'm just laughing because I'm so tired." (Seemed on the verge of tears.)

Moaned as though in pain. Laughed: "I was only laughing at the situation."

Cheerful surface but tense beneath.

Laughed. Apparently depressed and preoccupied. Rubbing head most of the time.

Relaxed in tub: "I don't mind my tub any more," and then within the hour, "Dear me, I never will get used to these tubs; I tire so easily."

Enjoyed movie, but wept during it because children reminded her of her own.

When nurse amused her she began to laugh and cry at the same time.

Pleasant manner on waking. Left breakfast to weep.

"If I ever get home, which I don't expect to do . . ." (joking manner).

Laughed heartily, then tense and agitated (in same evening).

## 6. Fears, Apprehensions, Somatic Sensations (Transient, Episodic):

Complaint of gas around heart; holds hands to heart.

Frightened on receipt of telegram; because the doctor was late coming to the ward.

Frightened by dreams while in tub. Heart pounding.

Heart thumping: "I did have trouble with it when I was 15."

"Heart is beating fast and skips."

Fluttering feelings in stomach.

"Fear tugging at the heart keeps me awake" (fear of insanity).

"I'm so afraid; lonely and afraid."

"Pain around heart; let me get out!"

"I'm panicky at the thought of going out for Christmas dinner."

From the excerpts cited one secures the picture of a restless, chafing, demanding, fearsome, apprehensive patient, a patient uncertain of himself and of his relation to his environment, insistent that something be done to help him but unable to accept a treatment prescribed by another than himself and aware of his own failure at managing his case. Such a condition differs from the true aversion depression in that the patient admits his illness, in fact, insists on it at every opportunity, whereas in aversion depression there is an attitude of denial of the facts of the illness so evident to others.<sup>1</sup>

*The Behavior Chart.*—The nurses' behavior charts show markings of "uninterested, brooding, sad," but also "restless, impulsive," and "anxious, apprehensive, picking and rubbing, afraid, panicky." This shows graphically the impure affects (i. e., affects less diffuse, with topical content) of tension and fear along with the more pure affect of depression. The uniformity of the markings throughout the stay in the hospital is significant. Month follows month, with no marked change in the overt behavior. This is in marked contrast to the more simple retarded depression the course of which is phasic.

In many respects these charts <sup>2</sup> resemble those in the agitated depressions of the involutional period, and may point to an etiologic and symptomatologic relationship. Especially to be stressed are the elements of anxiety, apprehension and fear—all directed toward impending danger, in contrast to the self-depreciation and recriminations for past events observed in simple retarded depressions. The somatic delusions, negations and monotonous motor agitation would, however, seem to separate the agitated depression clinically from the group of cases under consideration.

In some patients the continual chafing against hospitalization and the desire to do "something else" came to a climax in leaving the hospital against advice. It is a serious question what to advise the patient and family in such a case. One must give consideration to the suicidal risk and to the obvious need for supportive treatment. On the other hand, the fact remains that these patients find it hard or impossible to cooperate in treatment and resent help or cannot accept it. The advice given must depend on the preponderance of the risks and needs. A few patients insisted on being discharged and managed themselves well afterward. In one particularly difficult case the patient returned some time later to tell of his progress and to say that

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1. Examples of "aversion depressions" are cases 4 and 5 in Muncie, W.: *The Rigid Personality as a Factor in Psychoses*, Arch. Neurol. & Psychiat. **26**:359 (Aug.) 1931.

2. Corson, Harold: *A Study of the Behavior Chart in Cases of Thymergasia*, Am. J. Psychiat. **11**:73, 1931.

he had secured great help from his stay in the hospital, which he had been unable to realize at the time.

In general, the plan in the practical management of this chafing is to meet the patient on every reasonable ground and not to oppose discharge too strongly if the patient and family can arrange a supportive regimen which holds therapeutic promise. Occasional visits to the physician, with the feeling of freedom, will often accomplish more than closer contact with him under the cloud of duress.

*Physiologic Evidences of Tension.*—Some of the personal evidences of tension and the patient's bitter complaints concerning them have been pointed out. The somatic evidences of tension are no less impressive. They are: (1) tachycardia; (2) labile pulse; (3) abnormal curve for dextrose tolerance, with a high peak and prolonged plateau; (4) abnormal gastric secretion, hypo-acidity or hyperacidity, and functional filling defects in the duodenal bulb; (5) high blood pressure, both systolic and diastolic; (6) exophthalmos; (7) tremors, excessive sweating and flushing; (8) diarrhea; (9) seminal emissions, with increased sex desire; (10) eczema, hives, etc.; (11) local spasm of striped muscle (?).

Tachycardia with a labile pulse is the rule. In the majority of the cases studied the pulse rates varied from 60 to 120, with a general tendency to maintain a level well above 76. There are cases, however, in which the pulse remains slow in spite of obvious tension. Examination of the oculocardiac reflex and analysis of the gastric content also confirm a vagotonic preponderance. In such a patient, with a usual pulse rate of about from 60 to 70, the pulse may drop to 40 in sleep. The difference in pulse rate is therefore as striking as in another patient whose pulse rate varies from 80 to 120.

Acute exacerbations of the tendency to tachycardia are observed as reactions to situational and personality factors; e. g., one patient who chafed exceedingly against the hospital treatment always showed a marked rise of the pulse rate after his wife's weekly visits. She brought up the "outside" and his desire to leave the hospital.

An abnormal curve for dextrose tolerance with a high peak at the half hour or first hour and a prolonged plateau beyond the second hour is a common feature. Such a curve may resemble the curve in hyperthyroidism. The degree of abnormality often closely parallels the other clinical evidences of tension, and should not be overlooked when the status of the patient for parole or discharge purposes is being determined.

The gastric secretion is frequently abnormal. It may vary in either hypo-acidity or hyperacidity in the specimen obtained during fasting or show peculiar variations such as a normal or high percentage of free and total acid during fasting, only to be followed by an absence of free acid and a low amount of total acid in the three half hour specimens following an Ewald test meal. Several patients had been treated by internists for gastric or duodenal ulcer early in the course of the illness. In view of the general course one must believe that the hypersecretion and hypermotility were purely functional and symptomatic of a more fundamental disorder of mood with tension. Recently, such a patient in the medical wards proved to have a recurrent depression (attacks nine years apart) with tension and



prominence of gastro-intestinal involvement. The gastric acidity was increased. There was a filling defect in the duodenal cap. Under administration of atropine, however, the filling defect disappeared completely.

One might expect that hypersecretion in the specimens obtained during fasting and subsequently would be correlated with relative bradycardia, indicating a vagotonic preponderance, and that hyposecretion with tachycardia would point to a sympathetic preponderance. No such generalization has been possible. For example, one patient whose pulse rate was always about 50 showed the following acidity of the gastric contents:

|                        | Free | Total |
|------------------------|------|-------|
| Fasting:               | 0    | 9     |
|                        | 12   | 23    |
| Half hourly specimens: | 23   | 46    |
|                        | 32   | 44    |
|                        | 21   | 29    |
|                        | 14   | 22    |

For another patient of about the same age, also with a pulse rate persistently near 50, the following figures were obtained:

|                        | Free  | Total |
|------------------------|-------|-------|
| Fasting:               | 3.53  | 4.26  |
| Half hourly specimens: | 64.40 | 82.80 |
|                        | 6.40  | 8.64  |

These observations on pulse and gastric secretion have not shown results sufficiently parallel with the curve for dextrose tolerance to constitute a rule.

There may be a tendency to a rather high blood pressure, especially on admission, affecting both the systolic and the diastolic levels. This, with the appearance of exophthalmos (the patient has often a startled look) and tremors of the hands, suggests mild hyperthyroidism. The basal metabolic rate is generally of no significance, but this is not always true; one girl had repeated basal metabolic rate readings between +50 and +60 on a tension basis.<sup>3</sup> The thyroid appeared normal to palpation, and the patient presented enough atypical features to warrant the conclusion in the clinic for thyroid diseases of the Johns Hopkins Hospital that the condition was psychogenic. The condition improved rapidly with no specific thyroid therapy. In such a case, one notes a strong constitutional tendency to anticipation of trouble, which results in tension. Diarrhea is noted frequently, but it is an inconstant phenomenon associated with acute exacerbations of the tension.

At some time during the psychosis, increase of sex tension is noted. It may be present at the onset and be followed by a decrease, or it occurs later during the illness. This is in striking contrast to the decrease so regularly noted in the simple retarded depressions. This increase in sex desire is shown in an increase of seminal emissions, with demands to be allowed to have intercourse, in pains and dysesthesias about the genitalia, and in sexual dreams. As Féré<sup>4</sup> noted, the increase in sex desire and activity are symptoms of a preexistent tension and not the etiologic agent in producing the tension.

3. This case has been referred to in Katzenelbogen, S.: *Personality Reactions, Hyperthyroidism, and Dysfunction of the Autonomic Nervous System*, Internat. Clin., to be published.

4. Féré: *L'excitation sexuelle dans l'angoisse*, Rev. neurol. **10**:1022, 1902.



Over half of the patients showed at some time during the illness eczema, hives, acne, vesicular eruptions or maculopapular rashes (not better classified) with itching, which, in some cases, became exceedingly annoying. In one case the eczema was localized about the anus and had been present for some months before the patient came to the hospital. It appeared coincidentally with the period of philandering that brought on the state of tension and the subsequent depression. In none of these patients with cutaneous eruptions was there a significant eosinophilia. Cutaneous tests for sensitization were not made as a routine, but there was no history of allergic disorder, save in one case of hives. The conditions disappeared coincidentally with the illness, although in one obstinate case, with itching vesicles, roentgen therapy seemed necessary.

All these overt data, together with the specific complaints of palpitation of the heart, tightness about the head, gastric distress with eructation, and the specific sensations of itching, crawling, burning and pain referable to the skin, with quiverings of the abdominal viscera and sweating and flushing, indicate a nonspecific autonomic imbalance. Sometimes sympathetic, sometimes parasympathetic phenomena predominate in the same patient. Each patient has his own tell-tale evidence of tension. For example, one patient betrayed his tension best by a slight exophthalmos, which gave him a startled look when he was off guard. In conversation he was always most affable and covered up his tension. Another patient always had rhinorrhea at each exacerbation, and his sniffing betrayed him.

The possibilities are too numerous to mention and admit of no correlation. For the complaints of tightness of the scalp, tightness in the neck, stiffness in the back and pain in the testes one has no means of satisfactory examination, but there may be local spasm in the striped muscle (e. g., the cremasteric muscles may show tense spasm in contrast with cremasteric relaxation in retarded depressions).

It seems reasonable to suppose that tension would have its repercussions in all the integrative levels: in the endocrine-vegetative (for example, the curve for dextrose, exophthalmos, changes in blood pressure, etc.); in the striped muscle (local muscular spasms, tremors, etc.), as well as in the highest psychobiologic level.

#### EVIDENCES OF DEPRESSION

*Mood.*—The franker expressions of depression are: "Have thought of killing myself." "Melancholy." "Blue, depressed, crying spells because of the depression." "Feel it would be a blessing to die. Degenerated to the bottom."

Less frank expressions, which must be interpreted as depression in view of direct observation in the wards, the previous descriptions of personality and the familial tendency to depressions (and suicide) are: "Had a lot of trouble and that caused it—my nerves." "Inferiority complex—feel a moral weakling." "This illness is a sort of punishment for what I have done." "I've given up fighting." "I've let go of everything; it's all utter unreality." "Feel unreal and not sure of myself. Feel like I was trying to fight off a crying spell." "Afraid of being alone" (allied to "homesickness," the depressive equivalent observed so often in depressions of the climacteric period and the lonesome feeling of simple depressions).

As already stated, these patients are uniformly observed by the nurses as depressed, sad, brooding and lacking initiative. In practically all the cases the morning exacerbation and the evening betterment of mood are evident at some time in the illness. Occasionally an atypical variation is seen. For example, the patient will feel well on waking and have periods of depression in midmorning and midafternoon and then feel better in the evening. Some correlate mood with parole privileges—having to stay indoors, or being allowed outside the hospital grounds. Many complain of being “cooped up” as something hard to bear. The persistence of tension throughout the day is responsible for atypical variations, and especially for the feelings of fatigue which accompany the depressive feelings and which are a source of great complaint. One patient said, “I always feel best in the morning. By the time evening comes I’m so tired of living, I think I just can’t stand it any longer.” Some patients link the depressive mood with the somatic sensations.

The complaint concerning the mood frequently occupies a subordinate position in the patient’s evaluation, being masked by the specific somatic complaints or by fears or so attenuated that its true evaluation is evident only in connection with the nurses’ notes, the description of the patient’s previous personality and the familial tendency to affective reactions.

While there is the diurnal variation in mood common in depressive reactions, there are also characteristic quick shifts of mood from depression to elation, with tension accompanying one or both phases. For example (extracts from nurses’ notes):

Pleasant manner on waking. Left breakfast to weep.

Laughed heartily. Then tense, agitated (in same evening).

Loud, boisterous behavior.

“I feel like a million dollars tonight.” A little later, very depressed, does not want to do anything.

In good spirits. Did not seem at all nervous or tense. Then shortly, very nervous.

Joked and was jolly in early part of evening. Later seemed slightly more depressed, quiet; laughed less.

Descriptions of the mood as “ghastly,” “intense,” “frantic” and the like are perhaps more descriptive of tension, but with an underlying lowering of mood, rather an impure type of affect.

*Suicidal Risk.*—Almost all these patients at some time during the illness had harbored suicidal preoccupations, although none had actually made a suicidal attempt before coming to the hospital. Sometimes the suicidal preoccupation is expressed only in hypothetical terms which, however, should not mislead the examiner.

One patient at home on leave of absence from the hospital attempted suicide late at night with illuminating gas.<sup>2a</sup> It came as an irresistible impulse, without

2a. This is the patient referred to on page 346.

premeditation. This same patient had run away from home impulsively, being gone several hours each time, but had returned voluntarily. In these instances also, according to the patient, there was no premeditation or planning.

Two patients committed suicide after leaving the hospital; one had gone home against advice and the other to another hospital. These were impulsive persons whose plans for themselves while in the hospital were as changeable as a weather-cock, motivated by one purpose alone—namely, to do and be whatever was different from the *status quo* in the hope of achieving a release from trouble.

From the experience with these patients the suicidal risk must be considered grave, especially in the presence of fear, apprehension and panicky features, largely through the patient's impulsiveness and the danger of the tension rising to a climax of blind panic. Even in cases in which hypochondriac complaining dominates one should be cautious about parole privileges and should relax observation only when thorough acquaintance with the patient has established a working basis of cooperation. The risk of suicide is also serious for the reason that even in the patient's better moments he is never able to plan reasonably for the future. His principal drive is to "get away from here"; no dependability can be placed on his plans or on his ability to carry them out. It is exactly this feature which has finally forced him to seek hospital care.

The nurses' observations and the patient's unguarded statements to visiting friends will prove invaluable in determining the degree of depression present, as in short office consultations with the physician the mood may appear neutral or elated, the patient devoting his time to hypochondriac complaining.

*"Physiologic" Evidences of Depression.*—For the recognition of the depressive reaction much help is obtained from what the inexperienced person considers as purely physiologic features, especially disturbances in appetite, weight, gastro-intestinal function, sleep, sex activity and electrical cutaneous resistance. The degree of the disturbance in these functions is, to a certain extent, also a measure of the depth of the depression.

In simple depression, with the content definitely subordinate to the mood, there is ordinarily encountered a phasic disturbance in all these functions—poor appetite (even revulsion against food), loss of weight, constipation, insomnia, especially with early morning waking, a decrease in sexual desire and activity, and an electrical cutaneous resistance characterized by high back-to-back and high palm-to-palm readings.

The patients forming the basis for this study have uniformly shown disturbances in these features, but in a characteristically psychobiologic manner.

1. Appetite: The appetite in the hospital has in general been fairly good. The few patients with poor appetite have not presented any serious feeding problem. One patient feared eating because of gastric distress after meals; one man feared

getting fat (hypochondriac concern) and so ate insufficiently; a third had always been finicky with food. Several reported poor appetite early in the illness; this was not observed in the hospital. One woman had poor appetite, but "forced food to avoid losing weight." One man bolted his food, and "ate like a pig" according to relatives. This is reminiscent of increase of appetite as an outlet for sexual tension.

One finds, therefore, that inappetence in these patients never went so far as actual revulsion against food and never became the source of a serious feeding problem; when it was present to any marked degree it was based largely on ideational content or personality difficulties of long standing.

2. Weight: Owing, in all likelihood, to the atypical disturbance in appetite, the weight in all but two cases (somewhat beneath the ideal weight) varied little, and not phasically as in the simple depressions. For example, one patient, who was said to have needed coaxing to eat before coming to the hospital but who exhibited a good appetite during seven months there, weighed 145 pounds (65.8 Kg.) on admission, 148 (67.1 Kg.) being the ideal weight; the maximum weight in the hospital was 155 (70.3 Kg.) and the weight on discharge (improved, but not well) was 148 pounds. This is fairly typical of the group. Another patient, with poor appetite throughout her stay, weighed 106 pounds (48.1 Kg.) on admission, the ideal weight being 126 (57.2 Kg.); the maximum weight in the hospital was 115 (52.1 Kg.), and on discharge she weighed 113 pounds (51.3 Kg.).

This variation in weight stands in rather striking contrast to the marked losses and subsequent gains observed in more simple types of depression.

3. Constipation: Constipation occurred in about two-thirds of the cases, and diarrhea (to four stools a day) in one case. The other patients reported normal bowel action. In one case, with pyrosis, eructation and high gastric acidity, a spastic pylorus and colon were demonstrated by roentgen rays. It is not possible to say whether the constipation in the other cases was of atonic or spastic type, as roentgenograms were not made as a routine. Moderate doses of liquid petrolatum or dietary regimens sufficed to take care of the difficulty.

4. Sleep: Insomnia, of every possible type and degree, has been an especially difficult problem in these cases. It is significant as contributing to the diagnosis of fixation of the mood in depression that twelve of the fifteen cases showed predominantly early morning waking, with relatively little difficulty in falling asleep. Only when involvement of the thought content entered the picture significantly did the character of the insomnia change to difficulty in falling asleep or to broken sleep.

One patient, for example, early in the illness became concerned over a decrease in sexual power; this concern was reflected in difficulty in falling asleep. Later, in a more full-fledged depressive psychosis with tension he experienced little difficulty in falling asleep, but woke unusually early with tension and depressive thoughts.

Another patient whose insomnia was intractable and who required rather large doses of barbiturates to secure a semblance of adequate sleep showed early waking as long as the depressive features seemed prominent. As these dropped out and there persisted a rut of hypochondriasis based on symptoms of tension, a part of this physical overconcern became focused on the sleep function. The character of the sleep changed abruptly as interest in the treatment became charged with concern and apprehension, with a complete reversal of the picture—great difficulty

in falling asleep, with broken sleep and on some nights complete sleeplessness (in the accompanying chart the arrows point to the change in the type of sleep).

The patient previously mentioned, who attempted suicide while on a visit home, had difficulty in falling asleep and slept intermittently just before the visit. This change in his sleep was not observed and no inquiries were made as to its possible meaning. After the attempt, when the depressive features became more prominent, early morning waking was the prevailing difficulty.

The feature of early morning waking should carry considerable weight in distinguishing the presence of depression as the basic reaction, with tension as an added feature, from the tension states of a minor psychotic type (anxiety neurosis, hypochondriasis, hysteria) and other tension states more topically

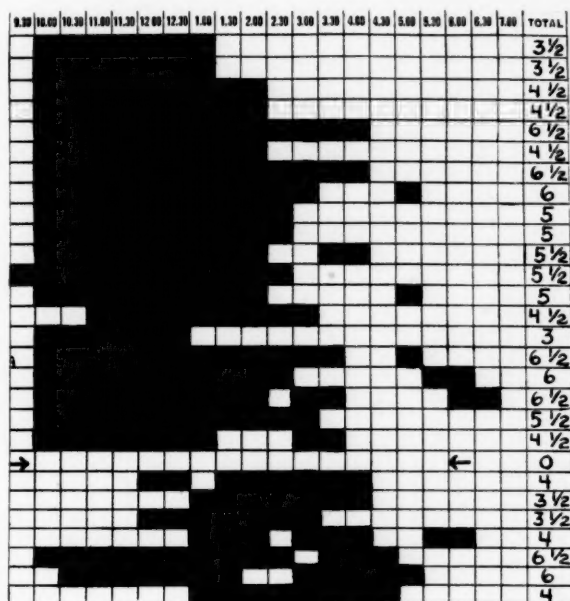


Chart showing the various hours of sleep and the change in the type of sleep.

determined (paranoid conditions, schizophrenic hallucinosis) in which difficulty in falling asleep is the rule, with predominance of content as opposed to mood as the basic factor in the psychosis.<sup>5</sup>

5. Sexual Activity: Decrease in overt sexual activity is frequent, but it is not a wholesale but rather a partial reduction. For example, one man no longer could have intercourse but had nightly emissions without erections, with sexual dreams. Another had morning erections without sexual craving. In both of these men, the sexual function had always been an important factor. Another man, also with a great interest in the sexual function, showed a diminution of interest and potency early in his illness. In the hospital, morning erections returned and, with exacerbations in the general state of tension, emissions occurred which then

5. The types of insomnia and their significance will be described in another publication.



frightened him because they were without sexual fantasy. In female patients, scant but regular menses were frequent, and in only one case (with congenital hypoplasia of the uterus) was amenorrhea observed, lasting six months at the height of the illness. One man declared that his sexual desire and power were as strong as ever, and in all but one of these cases we saw evidences that, in the presence of decreased spontaneous part-functioning, the decrease was not accepted without protest. For example, one woman, whose periods became scant and in whom orgasm disappeared, experienced an unreasonable jealousy of her husband and persistent hypnagogic hallucinations of male genitalia. Another, always frigid, with the onset of amenorrhea made desperate efforts to relax and to enjoy coitus. Two women with normal periods showed reactions of jealousy toward homosexual partners. One man, with little evidence of overt sexual activity and interest in the past, proposed marriage to the nurse on the day he arrived in the hospital.

In general, then, there is slight or no decrease in the physiologic sexual activity, together with episodes of sudden increase in sexual activity, leading to coitus, demands to be allowed to go to prostitutes, increase of desire during menstruation, increase in seminal emissions, dysesthesias about the genitalia, sexual dreams, sexual fancies, etc. In spite of the fact that in some cases the etiologic factor seemed clearly to point to sexual difficulty, in others the increase in sexual tension seemed to be symptomatic of preexistent general tension without special sexual content. These findings are in accord with those of Féré.<sup>4</sup>

6. Electrical Cutaneous Resistance: One of two types of readings have generally been observed: (1) high back-to-back and high palm-to-palm (common findings in depressions), or (2) low back-to-back and low palm-to-palm (findings in tension states of any sort).

#### PERSONALITY

When one attempts to describe the personality of these patients one has a double task—correlation of previous traits with the depression and with the tension features of the condition.

Surprisingly few of these patients are recorded as having been worrisome or moody previous to the illness, even though in about two thirds of the cases depressive reactions and numerous suicides had occurred in the direct ancestry and members of the same generation.

One sees people who have been superficially well adjusted, rather stubborn, accustomed to getting their own way, tenacious, rigid, aggressive and self-reliant, yet dependent on the environment. These people have been on the whole successful, with feelings of self-sufficiency. They generally took responsibility seriously. They thrived on success and were stimulated by it to more and more activity. In most cases they had never before been "unsuccessful," although perhaps largely because of formal skill, and had few assets to call on to sustain them in defeat.

Only one patient is noted as having been indecisive; he had had six previous breaks under strain, one of which was concerned with the necessity of deciding in regard to marriage. The others, because of peculiarly fortunate circumstances, in



which they were carried along by the very momentum of the set-up, had never been forced before to make decisions. As one patient said, "Only in the last few years have I had to make choices—I did not need to stop, look or listen before." This same patient stated his difficulty as follows: "The weakness, as I see it, is in some obstinacy of opinion and in an inability to cope readily with a new situation. I have got to develop flexibility." One sees here the kinship to rigidity. This question of the quality of the patient's decision is rather fundamental when one remembers the frequency of an unpleasant dilemma as the etiologic situation.

In spite of the predominance of hypochondriac complaints in the illness, previous physical concern was present in only two of the twenty-eight cases, and in these the patients were elderly men with from three to seven recurrent affective psychoses with tension; in one the gastrointestinal tract was acutely attuned to react to strain with pyrosis, belching and constipation.

Outstanding neurotic traits, such as obsessions and fears, were occasionally noted, and these were prominent in the psychosis.

Individual cases showed striking correlations between traits of personality and psychotic symptoms.

One man, aged 33, had always presented a strange paradox of fearlessness in the face of factual danger but abject panic in the face of intangible menaces, such as unexplained noises, illness of any kind or death. During the psychosis he was never concerned over pains with an obvious physical origin, but pains and aches resulting from tension were beyond his ken, and he became concerned and frightened by them. Fears of insanity and commitment to a state hospital were frequent fears in the psychoses.

The chafing and restlessness were in many cases alleviated by hard, driving exercise or by long walks. This was of interest in that some patients had always been busy, not happy unless "fussing about the house," continually on the go, "riding work and play to death." In other words, the patient in his psychosis utilized a habit which experience had shown to be helpful in reducing tension.

One patient had formerly used intercourse and exercise to reduce tension. In his illness he was forever "on the go," and while he did not have sexual relations there was a great craving for affection.

A large proportion of our patients showed an undue attachment to parents or parent-substitutes, making emancipation difficult when the life situation demanded decision between parents and parental protection and the attempt to live one's own life with its hazards. Craving for affection was frequently noted.

In summary, then, these people had been carried along to success by favorable environmental circumstances (especially parental protection); their own aggressiveness had met with no obstacles, so that their mettle in the face of difficulty had never been tried; they were rather sensitive to the environment and stimulated by success, using activity as

a means for the release of tension. The success was often of a superficial sort, dependent on display and on the approval of the environment for its support, and crumbling in a critical situation demanding a type of decision new to the patient, or through a succession of failures or diminishing satisfaction in life leaving the patient stranded with a poverty of assets with which to work toward rehabilitation. In most cases there was needed for rehabilitation a critical reevaluation of the patient's own estimate of himself with reference to his life situation, and this remained a difficult task because of the rigid, stubborn attitude and the life-long habit of getting his own way and of placing blame elsewhere.

These traits can to some extent be brought into evidence by appropriate psychologic tests.

The "dart test" was carried out by Dr. M. Hausmann.<sup>6</sup> This revealed: stubborn aggressiveness, shown in consistent overbidding, with hesitation in adjusting the bid downward in the presence of failure; insecurity and lack of confidence in underbidding, with a wide safety margin; sensitivity to load, with quick adjustments downward and cautious advancement upward, and lack of perseverance.

Most of the patients were studied with the "concentration battery" by Dr. Hausmann.<sup>7</sup> Slowness was demonstrated in about half of those tested. All but one of the patients tested were able to see the absurdities in the third portion of the test. This man, a college graduate, was tested repeatedly. He never presented any depressive slowing, yet was never able to see the absurdities. This man was also the only patient who adjusted his bid against the trend in the dart test. These two results point to some individual difference of a significance as yet unknown.

#### GENERAL PROBLEM OF TENSION

There seems to be no doubt that certain people react to given situations with tension combined with depression. These situations are customarily of a type in which the patient feels himself caught; all avenues of escape are equally uninviting and demand concessions which he cannot bring himself to make. Faced with this emergency and being unable to settle it in a satisfactory way, the elements of tension, apprehension, anxiety and fear enter and mount slowly and progressively. There are several ways in which the personality may deal with such a state of affairs. In a previous article the psycholeptic attack<sup>8</sup> was described as one method of dealing with a situation of mounting tension. By this means, the patient used an unusual experience for a conviction that his present and future are ruined, and presented customarily the picture of dejected resignation. The outcome of such a catathymic (i. e. topically

6. Hausmann, M. F.: A Test to Evaluate Some Personality Traits, *J. Gen. Psychol.* **9**:179, 1933.

7. Hausmann, M. F.: To be published.

8. Muncie, W.: The Psycholeptic Attack in the Psychoses, *Arch. Neurol. & Psychiat.* **27**:352 (Feb.) 1932.

affective) influence is equivocal but not entirely hopeless. At the time of writing the article mentioned it was noted that physical examinations gave essentially negative results, except for the somatic physiologic evidences of depression—anorexia, loss of weight, loss of sexual desire, constipation and insomnia. A review of the depressed patients presenting psycholeptic attacks will show, however, the persistence long after the attack of marked evidences of tension: the specific somatic complaints mentioned throughout this study, the labile pulse with marked tachycardia and the tendency to attacks of anxiety and panic. On this basis, one could accept Janet's definition of the psycholeptic attack as the "sudden lowering of psychologic tension" only with reservations. It seems more probable that in the depression reaction with psycholeptic attack tension is only partially diminished, and this only at the highest psychobiologic integrative level.

Depersonalization and unreality—"*les sentiments du vide*" of Janet—are the symptoms which most commonly follow the psycholeptic attack. In this connection, depressions with depersonalization and feelings of unreality not ushered in by the psycholeptic attack, were also investigated and again were found the labile pulse with tachycardia, tremors, excessive sweating, overactive reflexes—indications of the same type of autonomic imbalance as is seen in other tension states. One wonders whether the symptomatic descriptions these patients give are not in a negative sense the equivalent of the complaints of the more typical depressions with tension, for example, "Head feels numb; feet dried up and no feeling in them; teeth feel tight; head feels frozen up; skin doesn't feel alive. When I put my arms out, I feel a crackling. It's all dried up. Teeth feel as if they were touching the top of my head; feel dead; head feels funny; cracking in head"; nihilistic delusions concerning viscera, etc. Unreality and depersonalization are undoubtedly in part content-determined, as, for example, in a depressed patient who experienced these phenomena only when return to an unhappy home environment was pushed.

Another manner of reaction to tension has been stressed by O. Diethelm<sup>9</sup> in a recent paper on panic. Panic is the expression of a tension state culminating in maximal fear. It may occur as the leading feature of an illness or as an incident in a more inclusive illness. It is notable that minor (incidental and transient) panics are frequently noted in many cases of tension depression. Diethelm pointed out the prognostically grave danger from the disorganizing nature of certain panics. It may usher in a permanent process of disorganization—the schizophrenic development. It would be worth while to investigate such cases for the persistence of tension phenomena at the "physiologic level"

9. Diethelm, O.: Panic, Arch. Neurol. & Psychiat. **28**:1153 (Nov.) 1932.

long after the acute episode has passed (residual part-disorder). It is not improbable that the peculiar vasomotor phenomena of the schizophrenic patient are evidences of more lasting disorganization of the personality at the autonomic level, of the type seen in the acute phase of tension (panic).

The attack of anxiety is another and more frequent climax to tension; it is seen in the anxiety reactions as well as in tension depression.

The patient whose case is reported on page 338 showed, at different phases of his psychosis of submaximal tension depression, five episodes of flight (fugue without alteration of consciousness or of grasp of situation) and one panic with suicidal attempt. At the autonomic level he showed exophthalmos, tremors, normal basal metabolic rate and relative bradycardia, and after the panic a high curve for blood sugar over a prolonged period.

These depressions with episodic crises—psycholeptic attack, panic, anxiety attack or flight—are all genetically related to the tension depressions here described, which for the most part do not come to the expression of such climaxes. In general the tension in these patients operates at a submaximal level. If an analogy may be permitted, it is somewhat comparable to the crisis as opposed to the lysis reactions in massive acute infections. In the episodic manifestations the patient afterward experiences a feeling of sharp relief from tension. As Diethelm pointed out, after panic a euphoric, elated state may ensue. In these patients similarly were noted quick shifts in mood from depression and tension to elation, but each phase was transitory. In these cases of submaximal tension depression, the general impression from clinical observation is that the tension is reduced gradually by a slow process of attrition. The slowness of the process is seen in a patient who now, about fifteen years after hospitalization, finds it necessary to guard herself against certain factors which she has learned can cause a return of tension symptoms. The length of the relatively acute phase of the illness is probably one of the factors responsible for the frequency with which these reactions give rise to hypochondriac invalidism (based on the somatic sensations of tension) or to invalidism on the basis of apprehension and anxiety (obsessive fears). Generally the tension phenomena precede and outlive the depressive features.

#### TREATMENT

The greatest difficulty in the treatment of this type of patient is met with in gaining his consent to accept uninterrupted supervision. There is a tendency for these patients to do a great deal of "medical shopping." One patient had been going to seven doctors at the same time, each being unaware of the treatment given by the others. Patients in the hospital constantly abuse parole privileges to take medicines outside the

hospital, dabble in Christian science, etc. This activity is evidence merely of the general chafing against the *status quo* and a human desire to "see results," but coupled with an inability to get down to fundamentals in the discussion of etiologic factors or inability to make difficult decisions (which might involve future inconvenience or unhappiness), and also sometimes a poverty of internal assets of use in the rehabilitation. This chafing frequently culminates in a demand for discharge from the hospital; the policy has been to accept the demand whenever the family assumes the suicidal risk involved.

For the specific control of the symptoms of tension small doses of barbitol,  $2\frac{1}{2}$  grains (0.16 Gm.) from two to four times a day, will often bring about significant improvement. The prolonged continuous bath at body temperature is useful, but the loose cold wet pack is probably more effective in securing relaxation and aiding the induction of sleep. The small doses of barbitol during the day help materially to reduce medication for sleep, so that on such a regimen the total intake of sedative for the twenty-four hours may be actually less than would be necessary if it were given in a single dose for sleep.

Symptomatic treatment for the distressing physiologic complaints often helps greatly. Belladonna and alkalis for the vagotonic gastrointestinal symptoms, hydrochloric acid for hypo-acidity and soothing lotions for the eczema bring relief. Nothing specifically influences the tachycardia. Hydrotherapy and repeated small doses of barbitol are the best measures, but these do not guarantee a favorable result.

One of the most important points in the treatment is to be able to decide when the depressive element is no longer operative and merer-gastic rut formation is imminent or actually in progress. This requires close and intimate observation of the patient's behavior by nurses and physicians, and careful noting of his statements and especially of his response to being pushed into activity. There is no sharp line of demarcation; one usually errs in giving the patient the benefit of the doubt and treating him expectantly as being depressed, rather than aggressively as having fallen into a rut without depression. A patient with a severe case of hypochondriasis literally had to be pushed out of the hospital. Immediately sleep, appetite and general efficiency improved, and she faced frankly the known etiologic factors which she had denied or minimized throughout her stay in the hospital. Two years later she was much improved but still suffered at times with feelings of tightness about the head. The dilemma with which she was confronted and which she dodged has been heeded, with partial satisfaction.

Much has been learned about the essential factors producing tension and depression in these patients by indirect methods: Jung association tests, psychogalvanic and Rorschach tests and analysis of dreams. They prove especially helpful in these cases in view of the patients' reluctance



to replace diffuse complaining by intimate topical considerations. At times one has the impression that the patient, in a manner suggestive of the dissociative-dysmnestic process, hides from a consideration of the actual etiologic factors behind a screen of diffuse somatic complaints and apprehensions. In one case with anxiety attacks, panic and depression, the dysmnestic dissociative factor was proved beyond a doubt. More generally, the latent content is ready at hand and simply awaits a degree of emotional stability for its consideration. The maintenance of a hopeful, constructively optimistic attitude, as with all depressions, and gradual but firm pushing into activity to avoid the unpleasant formation of ruts are to be recommended.

The aim in therapy is the dissipation of the depression, then an attack on the tension phenomena through a distributive analysis of the symptoms themselves, the patient's concrete activity in specific situations, and especially his conduct under the fire of adversity, leading to a critical and constructive appraisal of his personality and the marshaling of unused and the development of new resources. This is a difficult task because the patient is not used to being constructively critical of himself. In four of the cases which ended successfully this was possible only after the patient had left the hospital—either against advice, only to return voluntarily later for consultative help, or forced out against his own wish because of the formation of a hypochondriac rut. Rather signal successes were achieved in two cases in the hospital through the awakening of an active interest in the study of the personality; partial success was achieved in four others, and failure occurred in five cases. In one of the latter, convinced of the presence of cardiac disease—his interpretation of his anxious invalidism—the patient committed suicide one year after leaving the hospital.

In common with the depressions with psycholeptic attacks or with panics, the depressions with persistent submaximal tension give one cause to pause and consider carefully the justice of the usual optimistic formulation in depression. In any case, even in the so-called attack psychoses, the expectant attitude is only one feature in the treatment, and the underlying understanding of the personality must be attempted.

#### SUMMARY

Tension depressions are a variety of psychosis, sometimes recurrent, more often not, with definite precipitating factors in an "intolerable" or at least not accepted situation with repercussions in the personality of the patient; they are characterized by lowered mood and by the objective evidences of depression, with marked evidences of tension as the outstanding feature. Tension is recognized by poorly directed strenuousness, with a certain restless chafing, by specific somatic complaints with reference to the head, gastro-intestinal tract and skin, as well as by



anxiety features referable to the heart and by evidences of vasovegetative imbalance with mixed sympathetic and parasympathetic preponderance as noted in the pulse, blood pressure, curve for sugar tolerance and metabolism rate, cutaneous rashes, diarrhea, etc. There is no constant vasovegetative syndrome.

The condition is usually prolonged—a year or more is not unusual—and tends to terminate gradually, often with residuals in the nature of hypochondriac or apprehensive invalidism after the evidences of depression proper are no longer found.

The typical depression with tension may be considered as yielding by lysis, in contrast to the more critical course of the depression with psycholeptic attack, panic or anxiety attacks.

The prognosis is doubtful and the treatment difficult, because of the patient's inability to arrive at a consistent working agreement with the environment and the inability to face his problems with decision.

The problem of tension, its clinical recognition, spontaneous evolution and treatment, is in its very nature complex. This study attempts to indicate the present status of the problem and some of the directions for future investigation. Research on the natural history of the leading symptoms of mental disease will afford the surest means of understanding "disease processes."

## HANDWRITING OF CRIMINALS

### AN EXPERIMENTAL STUDY

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The object of the work reported here was to find out whether the handwriting movements of convicted murderers differ significantly from those of convicted forgers. Preliminary tests had seemed to indicate that murderers were prone to make angular, spastic or compressed letter forms, while forgers tended to write in a more rounded style and to pay greater attention to the diacritical marks. It was hoped that further light on these points might be had by studying fairly large series of specimens obtained from prisoners serving time, respectively, for crimes of violence and crimes of deception. It was desired especially, however, to study the graphic peculiarities of murderers with reference to a quantitative time factor, and experience had shown that data suitable for this purpose could be obtained with a stop-watch simply by timing each convict's performance while he wrote the standard test sentence. It was presumed that such findings might be instructive in a dynamic sense because all of the time measurements would relate to a constant, definite unit of work. For it seemed obvious, figuratively speaking, that the first and the last letters of the test sentence could be likened roughly to the first and second screens of the Le Boulengé chronograph, an instrument used in measuring the velocity of projectiles.

### MATERIAL

Timed specimens of handwriting were obtained from 100 murderers, 100 forgers, 100 unselected noncriminals of both sexes and 6 abattoir "killers." As regards the source of the working material obtained from prisoners, the authorities at the Illinois State Penitentiary, Joliet, submitted 161 specimens for analysis, 81 obtained from murderers and 80 from forgers, while the remaining 39 samples were secured partly at the San Quentin Penitentiary, San Quentin, Calif., and partly at the San Francisco City Prison.

A few explanatory remarks seem necessary in regard to each of the four kinds of specimens studied.

*Murderers.*—As the factor of personality was an important consideration, it was desired especially to examine the handwritings of convicts who had committed murder by resorting to direct physical violence—not by means of bullets or poison, but by actually overpowering their victims. However, since details in regard to the crimes were lacking except in a few instances, it is probable that comparatively few of the members of this group could be included in such a category.

Complete data on the height and the weight were available for both the murder group and the forgery group. When these data were compared it was found that the average murderer was 5 feet and 7 inches (170.18 cm.) in height and weighed 150.3 pounds (68.15 Kg.), while the average forger was 5 feet and 8 inches (172.72 cm.) in height and weighed 152.3 pounds (69.08 Kg.).

Twelve of the 100 murderers were 20 years of age or younger, and 5 were over 50 years old. The average age was 32.15 years.

*Forgers.*—Undoubtedly, many of the convicts so styled had been convicted of falsifying signatures or similar criminal activities in which penmanship figured, but it should be stated that this group included not a few embezzlers and "confidence-game" men.

All of the forgers were more than 20, and 10 were more than 50 years of age. The average age was 36.47 years.

*Noncriminals.*—This control group intentionally was made as diversified as possible; for example, specimens were obtained from common laborers, housewives, physicians, lawyers, factory hands, business administrators, pharmacists, art students and patrolmen.

Complete data as to age were lacking, but the average age probably was about 40 years, as the group included a considerable number of elderly persons.

*Abattoir "Killers."*—These men were employees of the Swift Packing Company of South San Francisco. The concern carried several hundred meat cutters and skinners on its pay-roll. But since the task of dispatching the animals in the various "kills" was the special function of a class of men who did nothing else, it was possible to get handwriting specimens from only 6 professional killers. Two of these men were "beef-knockers;" the other 4 were hog-killers and sheep-killers. The average age was 31.8 years.

#### TECHNIC

Fairly accurate data as to the velocity of the handwriting movements were secured by timing each person's performance while he wrote the test sentence. This was done with a stop-watch that registered fifths of a second; in each instance the time measurements were made secretly, without the reactor's knowledge. As regarded the quality of spasticity, rough, working values were obtained as follows: On the assumption that a spastic movement was essentially an abrupt movement, marked by a sudden change of direction of the pen point, each specimen of handwriting was scored in this respect by a notation of the presence or absence of an angle or some other irregularity either laterally or at the summit of the looped letters h and l. As there were 8 of these letters in the test sentence, or a total of 800 in the case of each group of 100 reactors studied, it seemed fair to use such values for comparative purposes. However, as will be explained later, in some instances specimens were compared in terms of the total number of angularities present.

Other details in regard to the technic may be dispensed with here, as they were dealt with at length in an earlier paper.<sup>1</sup>

1. Quinan, C.: The Time and Lineage Factors of Handwriting, Arch. Neurol. & Psychiat. 26:333 (Aug.) 1931.

## EXPERIMENTAL RESULTS

It will be convenient to consider: (1) the various textual peculiarities noted in the writings of murderers and forgers and (2) the time data—particularly those that concerned the murder group.

TEXT DATA.—I. *The Murder Group*.—Inclination: In 98 of the writings the text sloped forward. In 2 its inclination was backward.

Lineage: This group was found to have an average lineage value<sup>2</sup> of 368.8 mm., while the corresponding figure for the group of noncriminals was 361.9 mm. However, the difference between these findings did not appear to be significant, because in the earlier study an average lineage value of 365 mm. had been obtained for 200 normal persons.

Spasticity: Irregular or angular formations of the letters h and l were noted 469 times in the specimens obtained from murderers and 283 times in those secured from noncriminals. It followed, therefore, that more than half of the murderers were unable to negotiate the curves of the test letters (table 2).

Configuration: Three types of writings were distinguishable: spastic-ataxic, spastic and nondescript.

TABLE 1.—*Comparison of the Three Graphic Styles of Murderers with Reference to Age*

| Style               | Number of Specimen | Age, Years |       |       |       |       | Average Age |
|---------------------|--------------------|------------|-------|-------|-------|-------|-------------|
|                     |                    | 18-29      | 30-39 | 40-49 | 50-59 | 60-64 |             |
| Spastic-ataxic..... | 26                 | 9          | 9     | 7     | 1     | 0     | 35.23       |
| Spastic.....        | 29                 | 14         | 9     | 2     | 1     | 3     | 33.05       |
| Nondescript.....    | 45                 | 26         | 12    | 6     | 1     | 0     | 29.95       |
| Totals.....         | 100                | 49         | 30    | 15    | 3     | 3     |             |

(a) The spastic-ataxic writings were characterized by coarse, sprawling letter forms, obviously produced by jerky movements of the pen. Lateral angularities in the letter forms were common. Often superfluous lines were present. With few exceptions these writings also exhibited wavy irregularities as regarded the horizontal alinement of the text (fig. 1; no. 2, fig. 2). Because of the limited data available, the question as to the relative frequency with which this easily recognizable style of writing occurred among criminals and the question as to its possible relation to other factors, such as age, race and personality, could not be answered definitely. However, it was found that of the 100 specimens obtained from murderers, 26 writings were of the spastic-ataxic type. In regard to the racial factor, it can be stated that 12 of the 100 writings were contributed by Negroes, and that 7 of their graphic records were of the type under consideration. Their samples of writing (fig. 1), however, did not appear to differ noticeably from those of the same style penned by white convicts. Although the average age of the 26 men who produced spastic-ataxic writings was somewhat higher than that of the entire 100 murderers, there appeared to be no correlation between this style of writing and the age factor (table 1). One other finding may be referred to as being seemingly of suggestive interest, at least in connection with the question as to the existence of a relationship between this type of writing and

2. This value was obtained by measuring the total running length of the text along its base-line.

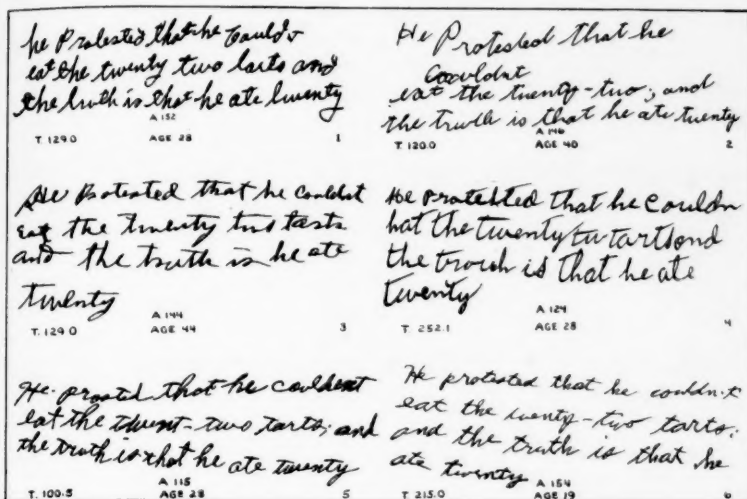


Fig. 1.—Spastic-ataxic writings of 6 first degree murderers—3 white men (nos. 1, 2 and 5) and 3 Negroes (nos. 3, 4 and 6). The two groups had about the same mean age value. A indicates the number of angularities in the test sentence, and T, the writing time in seconds. Note the untidy appearance of these writings and the characteristic ataxia of the handwriting movements, shown by the faulty horizontal alinement of the text.

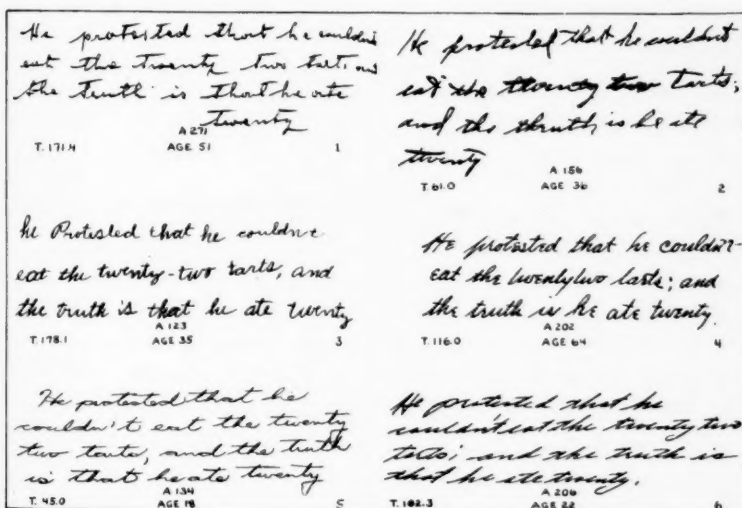


Fig. 2.—Various graphic styles of first degree murderers. Nos. 1, 4, 5 and 6 are spastic, no. 2 is spastic-ataxic, and no. 3 is nondescript. Compare nos. 4 and 6 as to general appearance, with regard to age, time and angularity values. Note in no. 5 the extraordinary compression of the vowels, particularly the letter a.

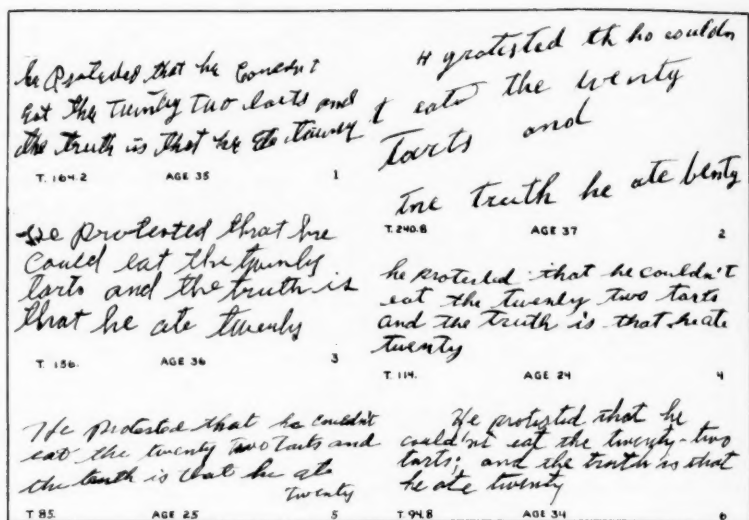


Fig. 3.—Handwriting specimens of 6 abattoir “killers.” Nos. 1 and 2 were penned by “beef-knockers” (the term arises from their use of sledge hammers), nos. 3 and 4 by hog-killers, and nos. 5 and 6 by sheep-killers. Note that all of these writings are of the spastic-ataxic type. Compare nos. 1 and 2 with the same numbers in figure 1.

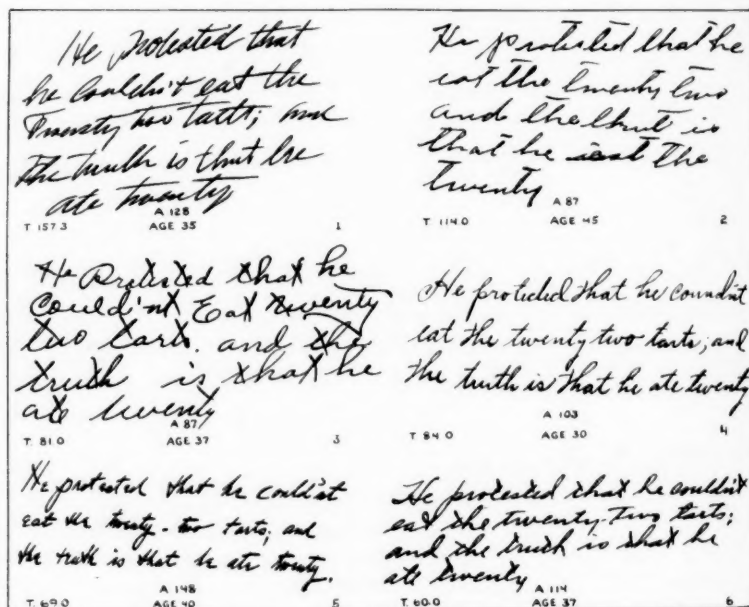


Fig. 4.—The handwriting of forgers. The specimens shown were unselected, except that in this and the next two figures they were roughly arranged in sequence according to their respective time and angularity values. Note in nos. 2 and 6 the eccentric t-crossings' diacritical arrhythmia.



a personality factor. This was that on comparing the graphic samples obtained from a small number of packing-house employees with those secured from some of the murderers it was noted at once, with respect to the type of configuration, that the two sets of specimens were much alike (figs. 3 and 1). Particularly striking was the resemblance between specimens 1 and 2 in figure 3, and the specimens with the same numbers in figure 1.

(b) The spastic writings were stiff-looking, serrated bits of script. It was remarkable that in many the letter forms were tall and spearlike, and that they often exhibited extraordinary degrees of lateral or vertical compression. In regard to the factor of angularity, the following facts were noted: By carefully writing out the test sentence and at the same time counting each angular change of direction, for example, 2 in the letter o and 1 in the letter h, it was found that there were 79 angles in the entire sentence. On proceeding, then, in similar fashion with each of the 4 spastic writings shown in figure 2, namely, specimens 1, 4, 5 and 6, the angularity counts noted were, respectively, 271, 202, 134 and 206.

So well marked were the aforementioned peculiarities of configuration that of the 100 specimens secured from murderers it was possible to set aside, without hesitation, 29 that were unmistakably spastic in type. On the other hand, as in the case of the spastic-ataxic writings (table 1), the age factor appeared to be unimportant.

(c) Included among the nondescript writings were 16 which were more or less spastic in type and a single specimen (3, fig. 2) the letter forms of which somewhat resembled those characteristic of the spastic-ataxic style. This specimen was written by a convict 35 years of age. The other nondescript writings were of various sorts, such as could readily be obtained from any mixed group of prisoners.

*II. The Forgery Group.*—Inclination: The slope of the text was forward in 85 specimens, partly reversed in 11 and fully reversed in 4.

Lineage: Since the average lineage value for this group was 386 mm., as against 361.9 mm. for the noncriminals, this evidence seemed to indicate that the handwriting movements of the forgers were considerably more energetic than those of the normal group.

Spasticity: In this particular the records of the forgers agreed closely with those of the noncriminals. The respective letter counts were 286 and 283 (table 2).

Configuration: With the exception of 7 specimens which were of the spastic-ataxic sort already described, a majority of these writings were rounded and definitely clerical in type; in fact, many of them could hardly be distinguished from those commonly met within the business world (figs. 4, 5 and 6). They certainly were unlike the unsightly scrawls and other peaked compositions obtained from the murderers.

*Comment.*—Cursory notes may be added here with respect to two peculiarities noted seemingly with unusual frequency in the handwritings of forgers. One of these peculiarities was that many of the bits of script penned by these crafty law-breakers (for example, specimen 6 in fig. 5 and specimen 2 in fig. 6) were unmistakably calligraphic; the other was that in many instances the t-crossings were dashed in eccentrically in such a fashion as to form more or less acute angles with the base-line of the text (specimens 3 and 6, fig. 4). Records thus marked presented a remarkable appearance—a kind of diacritical arrhythmia. Presumably, deflection of the t-bars in this eccentric manner was indulged in for the purpose of

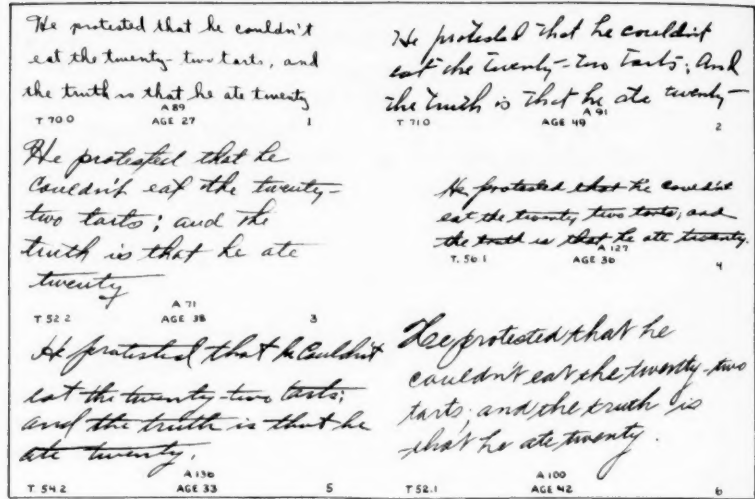


Fig. 5.—The handwriting of forgers. No. 6 is calligraphic.

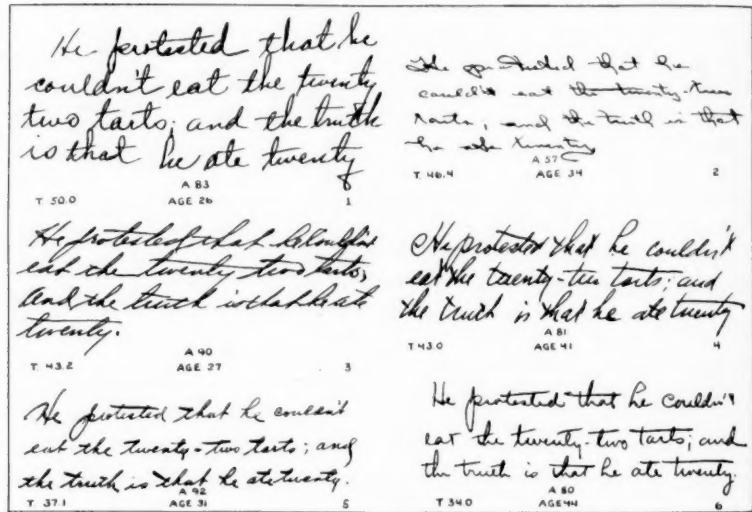


Fig. 6.—The handwriting of forgers. No. 2 is calligraphic; in this specimen, the preceding one and no. 3 in figure 5 the elaborately flourished return bend of the final y seems to indicate pride in penmanship. Note the long, freely running t-crossings in all of these writings; in no. 4 they are placed eccentrically. As compared with the specimens shown in figures 1 and 2, note that those exhibited in figures 4, 5 and 6 are much more rounded.

embellishing the text. But since it is customary to put in the t-crossings with horizontal strokes, any deliberate modification of these natural movements would seem, on the part of any given writer, to be indicative either of self consciousness or of a state of undue awareness about the movements of the handwriting mechanism. Concerning the question as to the relative frequency of this practice in the groups under consideration, it can be stated that 23 examples of diacritical arrhythmia were found among the specimens obtained from forgers, while the

TABLE 2.—*Writings of Noncriminals, Forgers and Murderers Compared with Reference to the Average Time Values and the Numbers of Angularities and Eccentric T-Crossings*

| Persons Tested        | Average Writing Time in Seconds | Form of Loop in the Eight Test Letters |                       | Number of H's Lost | Eccentric T-Crossings, per Cent |
|-----------------------|---------------------------------|--|-----------------------|--------------------|---------------------------------|
|                       |                                 | Number of Angular Loops                | Number of Round Loops |                    |                                 |
| 100 noncriminals..... | 48.6                            | 283                                    | 504                   | 13                 | 4                               |
| 100 forgers.....      | 68.0                            | 286                                    | 503                   | 11                 | 23                              |
| 100 murderers.....    | 101.1                           | 469                                    | 306                   | 25                 | 1                               |

TABLE 3.—*Relative Handwriting Velocities of Normal Persons and Criminals, Showing Frequency Distributions of the Time Data Obtained by Means of a Test Sentence*

| Reactors            | Number of Specimens | Writing Time in Seconds |       |       |       |         |
|---------------------|---------------------|-------------------------|-------|-------|-------|---------|
|                     |                     | 25-39                   | 40-59 | 60-79 | 80-99 | 100-250 |
| Normal persons..... | 100                 | 25                      | 58    | 14    | 0     | 3       |
| Forgers.....        | 100                 | 9                       | 37    | 31    | 10    | 13      |
| Murderers.....      | 100                 | 1                       | 19    | 21    | 18    | 41      |

TABLE 4.—*Comparison of the Three Graphic Styles of Murderers with Reference to Time*

| Style                | Number of Specimens | Writing Time in Seconds |       |       |       |         | Average Time |
|----------------------|---------------------|-------------------------|-------|-------|-------|---------|--------------|
|                      |                     | 25-39                   | 40-59 | 60-79 | 80-99 | 100-250 |              |
| Spastile-ataxic..... | 26                  | 0                       | 0     | 1     | 2     | 23      | 146.45       |
| Spastile.....        | 29                  | 1                       | 5     | 4     | 4     | 15      | 100.10       |
| Nondescript.....     | 45                  | 0                       | 14    | 16    | 10    | 5       | 75.74        |
| Totals.....          | 100                 | 1                       | 19    | 21    | 16    | 43      |              |

percentage values noted for the murderers and the noncriminals were, respectively, 1 and 4 (table 2). It is of interest in this connection that of 100 art students who wrote the test sentence, 9 placed the t-bars eccentrically.

TIME DATA.—Attention should be called to a minor source of error noted in the course of the experiments. This was that in many instances when two successive trials of handwriting velocity were made with the same person, the time values thus obtained failed to agree. For example, 68 double tests of this sort carried out with 34 murderers and 34 forgers gave the following results: In the case of the murder group, the first stop-watch readings were larger than the second in 27 instances, while the second were larger than the first in 7; on the average, the second speed trials were 8.3 per cent faster than the first; in the case of the forgery

group, the corresponding first two values were, respectively, 25 and 9, while the second trials were 11.1 per cent faster than the first. However, these inequalities in regard to the time factor seemed to be of comparatively little importance in the total group values.

The general time data obtained in the course of this research are set forth in tables 2, 3 and 4. As the various experimental results thus displayed speak for themselves, few remarks about them seem necessary. However, it may be pointed out that they would appear to prove conclusively: (1) that the writings of the murder group differed significantly from those of the noncriminal group in the sense that those of the former group were produced in a much slower tempo, and (2) that the bradygraphia seemed to be associated closely with a spastic-ataxic type of text configuration (table 4). On the other hand, the time data referable to the forgery group did not seem to be remarkable. To be sure, the stop-watch readings gave this group an average of 68 seconds on the test sentence, while 48.6 seconds was the figure obtained for normal persons. This disparity was attributable largely, however, to the fact that of the 100 writings of those who had committed fraud 7 were spastic-ataxic in type, with high time notations.

#### SUMMARY

1. A practical method is presented for the evaluation of the time and configuration factors of handwriting.
2. Experimental findings in regard to these factors in the writings of 100 murderers, 100 forgers, 100 noncriminals and 6 abattoir "killers" are described.
3. The averages for the writing time of noncriminals, forgers and murderers were, respectively, 48.6, 68.0 and 101.19 seconds. Hence bradygraphia would appear to be characteristic of murderers.
4. The total angularity figures obtained for the same groups, in the same order, were 283, 286 and 469. For this reason the writings of murderers were unsightly and full of irregularities and were wanting in roundness, the quality that distinguishes the writings of forgers.
5. The writings of the abattoir "killers" were similar in every respect to those obtained from murderers.

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## HISTORICAL NOTES ON CONSTITUTION AND INDIVIDUALITY

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In the days of Hippocrates and of Aristotle knowledge of biology, judged by what is known today, was meager. Generalizations were comparatively easy and differed only slightly from a universal form of folklore and mythology. These formulations contained the intuitively felt kernels of truth, precipitates of long human experience, bound in time by structure and function, even though there was neither extensive individual observation nor planned experimental verification behind them. They were semantic aggregates of a "Volksgeist."

Thus, picking out at random items from Garrison's attractive summary of medical proverbs, aphorisms and epigrams, one finds in the proverbs of West Africa: "Pus (scandal) will not flow from a boil you do not have"; "Big elephants often have small tusks"; "The child of a leopard will be a leopard." Among the proverbs of Ireland are: "The daughter of an active old woman makes a bad housekeeper"; "A wild goose never laid a tame egg." In China: "A wife's leprosy does not pass over to her husband"; "Intermarriage of blood relatives affects the offspring."

One might continue at great length and present a formidable collection of these early aphorisms. The Hebrew Bible has many others which indicate the faint beginnings of formulations about what in present day thought has come to be more precisely dealt with under the general medical conceptions of disease, of causality and of developmental anomalies in all the fields of medicine. "Water will find its way" is one of the aphorisms alluded to, and it devolves on a historical survey to give some glimpses of the pathways followed from the early upspringing of tradition to the swollen streams of present day activities.

It would be a pleasing conceit for me to imagine myself capable of reversing the time-binding and space-traversing processes in some super light-year airplane and unroll the time-space cartography of this flowing stream from folkloristic humoral pathology, which even in the days of

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the early Greek philosophers was made a subject of their thoughts. Garrison, quoting from Matthew Arnold's Empedocles of Etna, wrote:

We mortals are no king  
For each of whom to sway  
A new-made world upsprings,  
Meant merely for his play;  
No, we are strangers here! the world is from of old  
Born into life!—in vain,  
Opinions those or these,  
Unalter'd to retain  
The obstinate mind decrees:  
Experience like a sea, soaks all-effacing in.

—  
This is not what man hates,  
Yet he can curse but this,  
Harsh Gods and hostile Fates  
Are dreams! this only is—  
Is everywhere; sustains the wise, the foolish elf.

The fate of Icarus, however, is a sufficient warning for the "foolish elf". Hence my apologia for but a brief, halting and fragmentary touching on a few points on the journey from folkloristic phrases concerning disposition, diathesis, dyscrasias, idiosyncrasies, heredity, temperament, character and constitution to the multitudinous dichotomized activities of research in the medical biology of the individual, as formulated, for example, in Brugsch and Lewy's four volume "Die Biologie der Person."

It is a thankless if not an impossible task to trace through all its ramifications an accurate pedigree of a "conception"; or, as Cowper puts it, "To chase a panting vocable through time and space." The paleontologist may offer a satisfactory and convincing picture of the development of eohippus, "no bigger than a fox who wandered five toed o'er Tertiary rocks," to the noble single-toed Equus of today. With a rare *tour d'esprit* Henry Fairfield Osborn has done this in his story of the evolution of the horse.

But, not to anticipate unduly, it may be premised that my problem is not so easily or so firmly fixed in its contours by purely morphologic considerations, even though some of its most secure outlines may be sketched in terms of a "constitutional anatomy," as Brandt (1933) has attempted in recent times. A human biotypology, to use Pende's phrase, which for him integrates the ancient fundamental conceptions of constitution, temperament and character, envisages more than purely morphologic considerations, even though these be conceived of in physical, chemical or biologic frames of reference, or more vividly "panels" (Draper), and would include the morphologic-physiologic, the biochemical and the psychic. Pende likened his pyramid to a triangle, the base of which includes the hereditary patrimony of the individual (the geno-



type of Johannsen, the idiosyncrasy of Siemens), and the three sides of which we may, like Napoleon, envisage as the morphologic face, the "habitus," the psychologic face, related to character—temperament and intelligence—and the neurochemical aspect roughly envisaging the vital forces of neural and chemical integrations among which the ancient vitalisms are resurrected in the chemical energies of the hormones and vitamins. Thus Pende saw his biotype, or vital type, as an expression of the somatopsychic individual.

From the point of view of the hypothetical airplane the historian cannot escape recognizing that with undefined terms one ends where one started. Running throughout one sees the silent, structural creeds, or metaphysics, just as true for disposition, diatheses, dyscrasias and idiosyncrasy as for temperament, constitution and individuality. Weasley regards these as so elusive that for some five or six years a special *Jahrbuch* has been provided by Utitz in order to run even a few of them into some sort of trap and fix their elusive meanings. Something always escapes. The structure of human knowledge is such, however, that this cannot be entirely overcome. It is this "becoming" aspect of wisdom that continually upsets the applecart of static dogmatism and definition.

As a cosmologic assumption this "becoming" is everywhere evident. "Whatever it is, there is life, experience, change, action. Behind it lie the cinders of events that no longer happen; in front—there is nothing yet" (Whitehead, Winn).

When Napoleon gazed in awe-struck wonder and admiration at the pyramids of Gizeh and uttered those memorable words, "Forty centuries look down on you," little did he or his contemporaries pause to reflect on the infinitely mightier spectacle of the human pyramid of accumulated experience within every living human being.

Every such being stands at the apex of a pyramid whose foundation was laid, not forty or four hundred, but millions of centuries ago. Man is not only a crown but also a concentrate, an aggregate of all this experience through binding in endless time. And man is but a pilgrim still on his way. Little wonder, then, that no words of poet, prophet, philosopher or seer can render an image of the splendor or magnificence of this heritage of man, living on one of the hundreds of millions of stars in this expanding universe. History is blind concerning the reconstruction of what happened when "life insinuated itself into dead matter," the forty elements of which afford the physicochemical matrix at the bottom of the pyramid.

When Chellean man chiseled his flints on one side and when twenty thousand years later Aurignacian man learned to chisel them on both sides, already there existed the almost finished products of what today we, as scientists, are pleased to call "human constitution." Even here we have only prehistory.

In the opening paragraph of Prinzhorn's chapter on "Biology and Pathology" I find a phrasing which may be utilized to start this historical glimpse at the present day formulations; then follow their antecedent ramifications, earlier developments and origins relative to the interesting problems connected with "individuality" and "constitution."

"The task of investigating the constitution has for its chief problem this," wrote Prinzhorn:

How far is the individual unequivocally determined as to his disposition by inheritance, and how far, on the other hand, does he possess freedom of development?

In essentials, this problem could probably be solved theoretically, were it not used as a weapon in world-philosophical disputes carefully disguised as these often are; for thus used, it heats tempers instead of cooling heads and inducing objective thinking. If we seek the real motivation of the decisions arrived at by many investigators on this fundamental question—one preliminary to all biological thinking—we find it, to say the least, strongly influenced by the logical conclusions which must be drawn from these decisions for the whole world picture. It is surprising to find that, as experience shows, even extra-human biology may serve as a proof and support of political party-programmes. Yet surely there are here some facts which are true for everyone, whatever may be his views of politics or of the universe.

Thus at once it may be urged that the problems involved in the subject chosen for this research program are of wide and deep significance; not alone the more restricted field which is our special interest, medicine, but the entire domain of the "*Geisteswissenschaften*," especially religion, esthetics and sociology, may be drawn within the sphere of influence by discussion of the many facets of the constitution-individual situation.

However much one might be tempted to throw a net around and attempt to haul in the larger possibilities which a historical outline permits, the present enterprise will perforce limit itself to but a meager catch of some of the more salient aspects of the entire field, leaving for those who follow to complete the more detailed survey which the subject so alluringly invites and for the accomplishment of which they are so eminently fitted.

It is an intellectual heritage from time immemorial that not only are sick people to be distinguished from healthy ones and from one another, but also healthy persons are almost, if not quite, as variable. Healthy persons have their dispositional or premorbid individuality. Such signs or symptoms, which are not in themselves diseases, may, according to Siemens and others, be described as constitutional symptoms. Certain combinations have been recognized for centuries, and for such constitutional anomalies the terms diatheses, dyscrasias, dispositions, temperament, character and idiosyncrasies have been employed at different periods.

As in the past, so even today, despite all that present day observations have collected, the conception of constitution is far from being definitely laid down. The outlining of the intimate details of the concurrent and conflicting theses does not fall within the scope of this sketch. With Mathes, Tandler, Siemens, Julius Bauer and the Vienna school there has emerged a series of ideas concerning constitution which show sharp divergencies in details from the ideas Martius spoke of as inherited and acquired constitutions.

One also sees the rise of the Berlin school of Lubarsch, F. Kraus, Brugsch, with their neohippocratic humoralism on the one hand (Brownian), and the development of the anthropometric tendencies of the Italian school of Giovanni, Viola, Pende, Naccarati, Draper and others in slightly or markedly divergent directions. Hereditary and not hereditary, Siemens reminded us, are not technical terms; they are not symbols for definite, sharply circumscribed conceptions. They are popular terms that are loaded, as it were, with numerous confusing conflicting significances. With the erection of such terms as genotype, phenotype (Johannsen) and mutation (de Vries), the true "hereditary" conception may be distinguished from the popular term used by the nonbiologically trained public. Such more precise conceptions are essential in the development of present day constitutional pathology. One aspect of it is merged with heredobiologic conceptions. Siemens therefore introduced the terms idiotype and paratype. As idiotype he distinguishes the sum of all the inherited anlage of a subject, his heredo-anlage foundation or, chemically expressed, his constitutional formula. By paratype are to be understood the factors that are not inherited but result from the environment, to which the cells and organs constantly respond for good or evil. These are fictional constructions. What one observes in clinical medicine is the phenotype. Idiotypic and paratypic anomalies are to be distinguished.

In 1922, in a work of four hundred and thirty-five pages Carl Hart offered a digest of the literature on constitution and disposition; over three thousand titles were sifted. The conflicting aspects of these studies as seen through Bier's eyes will be alluded to later. But there are other and more important aspects. Since 1917 Julius Bauer and his co-workers have collected bibliographic references to all possible contributions which might aid medical science to arrive closer and closer to better and better generalizations. I have before me the bibliographies of 1928, 1929 and 1930. In these are cited one hundred and fourteen pages of titles covering approximately three thousand separate studies. It may be left to one's imagination how far a conscientious student of the problems must go (as Neuburger began in 1913) should he attempt the historical ideal of an all-embracing recapitulation even of three years'

investigation, to say nothing of the period since 1914, when Martius offered his more precise formulations of what should be conceived as the conceptions of constitution.

As is so true for any flux, and especially of such a mighty one, the interrelated flowing aspects have a variable rise and fall. Mendel was not the first student of heredity, but the historian sees in his work a decided advance in the technic of genetics, the importance of which has been recognized by the bestowing of a Nobel prize on the researcher who has immortalized the fruit fly *Drosophila*. What *Oenothera*, the primrose, was to de Vries and the students of mutation, *Drosophila* became, through the work of Morgan, to the student of those more fixed elements in hereditary structure, the genes.

I shall mention but a few names in this marching army of those who have contributed so widely and deeply to the study of the genetic component in constitution and its relation to disease in general and to disease of the nervous system in particular. Galton and the biometricians doubled on the seemingly logical Pythagorean trail of exact counting and measuring (Benjamin). Johannsen offered the genotype and phenotype; Siemens remodeled the conception into the idiotype and the paratype. The term "genetics" more or less crowds out the term "heredity"; the genes and chromosomes, "the hereditary factors," and Darwin's epigenesis have faded out of the picture. Lamarckian vitalistic trends still struggle for recognition. The Dryad of vitalism will not down, even with the mechanistic triumphs of Pasteur and of Virchow and the organicist flow in pathology which started with Morgagni and Bichat a hundred years ago.

I shall leave the entire sketch of the vitalistic and materialistic theories to the readers of Driesch and of Lange, in whose works one may find the masterly portrayal of the respective aristotelian and democritian developments. A historical precipitate from these superb expositions would tend to the position that present day biologic science finds advantages in the utilization of both sets of propositions—a static teleology which leads to mechanism and a dynamic teleology which leads to vitalism. The antithesis either/or is partly reconciled in the compromise and/or.

As a sidelight on the neolamarckian position, the historian finds some interesting observations concerning inherited defects of mutation from the use of phototherapeutic and other influences on the germinal tissues. More recently Paula Hertwig has called attention to these, and Luxemburger spoke of them as being paralleled in the experiments on *Drosophila*. The inference is unescapable that through injuring the germ cells hereditarily defective mutations can be produced. Although the words

"acquired characters" are missing in the various discussions, they lie close to the fringe of memory for one who has followed the lamarckian discussions.

The historian cannot leave this touch and go on to genetic problems without a slight reference to twins, the histories of four thousand pairs of which are available (Verschuer). In present day studies of the relations of constitution and individuality the study of twins has opened up important lines for research. As early as 1914 Siemens was able to collect data for a work of two hundred and eighty-six pages and the student is referred to this work; additional suggestions are to be found in the studies of Lange and in the useful recapitulations of Luxenburger, Verschuer and others.

In the study of monozygotic twins the ideal seems to be reached for the classification of the comparative significance of hereditary constitutional and environmental individual factors. The historian is not called on to decide whether, with Lange more particularly, fixity of reaction is to be urged, or with Muller, Seeman and Saudek and Newman, among others, the theory that identical twins show differences in personality, i. e., show individualistic manifestations. There are few extensive researches on homozygous twins who have been separated from birth. Until a number of these have been studied, as for example those of Muller, Siemens and Newman, there will be no answer concerning the psychic factors at least, and perhaps crucial information may be gained as to what possible influences a radically different environment may have on supposed inborn morphologic constitutional constants. At present I have not entered into the rich domain of such studies as they pertain to lower animal and plant forms, although I am cognizant of the fact that these are important questions which have been in active debate for years. In the study of the insects, for instance, lie particularly fertile fields for such investigations regarding which one may look to Wheeler, Whitney and others and to the ecologists for illumination.

Focusing the eye on another current within the flux, one is struck with the sharpening of concepts along anthropologic biometrics. Benedetti has summarized some of these. Here I must, for the moment, mention *origins* in the habitus apoplectic and habitus phthisicus of hippocratic days. That these classifications for "habitus" should have survived through all the centuries indicates sound observation as well as extreme mental indolence. Viola and de Giovanni have brought into sharp relief the Italian anthropologic school, which, it may be noted, is but a companion piece of the French school, with Manouvrier and McAuliffe as sponsors, the Kretschmer German trend, so ably discussed by Wertheimer and Hesketh, and a full crop of anthropologic biotypologies which have developed from the days of simple unaided inspec-



tion to the present time, characterized by the use of calipers and instruments of precision that threaten to obscure the vision of the woods through myopic preoccupation with the trees.

Biotypology lies close to, is intermingled with, and in many quarters is thought to be conditioned by present day formulations of "endocrinology." With Cushing—and the study of the pituitary—as a leader I see a mighty army of advancing eager researchers, hoping to find the keys to universal understanding in the hormones, vitamins and related organ precipitates of experience, handling certain chemical, energetic transformations.

Garrison, in his marvelous sketch of the history of endocrinology contributed to Barker, Hoskins and Mosenthal's work on endocrinology and metabolism (1922), traced the history of the thyroids from the time of Galen and Vesalius (1543), who described them more distinctly, as did Eustachius (1552), while Wharton (1656) gave them their name. The thymus was known to Rufus and has always remained a puzzle. Knowledge of the pituitary dates from the time of Galen. Vesalius named it in 1543, and in 1778 Soemmering gave it the name "hypophysis" and related it to the encephalon. With Eustachius (1563) the history of the suprarenals began. Rootanus (1628) named them. The pineal gland has always attracted curiosity, and the theories concerning its structure and function are most instructive and amusing. In recent years Marburg has contested the century-old libel on Descartes' notion concerning the function of these glands in relation to the soul.

Modern endocrinology arose late in the eighteenth century, after sympathetic magic had built up a *Dreckapothek* which through the fifteenth, sixteenth, seventeenth and eighteenth centuries provided marvelous curative agents from every conceivable animal or vegetable product and finally declined, so that by 1790 "wood lice" were the only remnants of this rich organotherapy in the old pharmacopeias. Theophile de Bordeau (1767) is credited by Garrison as being the originator of, and Brown-Séquard the real stimulus to, modern endocrinology. One also owes to Bordeau the welding of the conceptions of constitution and temperament (Wolff). I do not intend to trace this evolution much in detail. I shall state only that a revived and more subtle humoralism still persists in the general hormone theory, while newer neurologic hypotheses assert the importance of the vegetative nervous system in the integrative action of this type of "tool."

Since Brown-Séquard is partly one of us, it may be recalled that some time after Addison (1855) announced his discoveries, Brown-Séquard excised the suprarenal glands (1856) and contributed materially to the development of knowledge regarding the functions of these



bodies. It must be recalled that Brown-Séquard performed his rejuvenation experiments on himself as late as 1889.

I am certain that Dr. Barker in discussing the "Tiefenperson" will give the up-to-date platform of the "Kraus" school, which perhaps more than any other program presented in present day studies of "constitution and individuality" may be said to bring to full efflorescence the intrinsic humoralism of our forefathers. This takes one into the physicochemical foundations of the "Person." I leave to him the pleasure of sketching this broad substructure.

Up to the present, the findings of psychopathology have not been sufficiently organized to permit of radical intermingling of its conceptions with those of the geneticist, the morphologist, the endocrinologist or the neohippocratic humoralist. One can thereby realize the difficulties of Jaspers, Kahn and others in their advance on this general salient.

One band of intrepid explorers in psychopathology is following the trail of the unconscious wish component—or, more biologically expressed, the ecologic adaptation factors which bring about compromise reactions in the organic instinct strivings in the face of factual sociologic ideologies, economic stresses and environmental realities. At present there is no time to point out the evolutionary significances of the freudian methodologic findings as related to individualistic modifications of potent genetic constitutional factors.

I have chosen to direct attention at this point to the end of an efflorescent era that preceded the sharp pruning which the geneticists have imposed on the constitutional concept. Only in 1884, Jonathan Hutchinson, writing on temperament, idiosyncrasy and diathesis, opened with the thought that these subjects "are by no means in professional favour," and today, as in the days of the Father of Medicine, no topic of medical interest is thinkable without the conception of constitution. Hutchinson reminded physicians of their shortsightedness in that they were then and are even now so prone to write of "diseases" rather than of something that lies deeper within the human organism, which the ancients thought of as diathesis, and concerning which they made elaborate classifications, even like the present fashion of establishing constitutional types. In the development of English thought the names of Laycock and Jonathan Hutchinson stood out with much prominence in the period just preceding the blossoming of the conceptions of Mendel, Johannsen, Bauer and Martius, and the postwar efflorescence and rearrangement of the notions of diathesis, dyscrasia, idiosyncrasy, temperament and character. In the eighties of the last century Hutchinson's "Pedigree of Disease," although distinctly popular, had a certain value even though it lacked much of the profundity of German thought of this period. In more recent years Garrod carried the thoughts into present day figures.

One cannot follow Hutchinson very far when he introduces the nosologic conceptions of the day, for a complete series of new orientations have occurred when one speaks of gout, rheumatism and leprosy, which were the mainstay of his argumentation when he said that "rheumatism is a modification of the catarrhal diathesis, mainly nervous in its origin." Where, for instance, are the rheumatisms caused by the pressure of a tumor of the sacral cord on a sciatic nerve or the "rheumatisms" resulting from a tabetic process? One gets nothing but etiologic confusion from the nosologies of these days, but they are historically interesting.

Temperament—or the "temperature of the mynde" as Wilson (1553) quaintly put it—is dealt with by Hutchinson as the sum of the physical peculiarities of a person, exclusive of all definite tendencies to disease. This may seem to fall into purely morphologic phenotypic genetics, and I note the wide discrepancy between this present series of conceptions and those of temperament which were so acutely discussed by the hippocratic physicians who spoke of: (1) the sanguinary temperament, due to a harmonious abundance of blood; (2) the choleric temperament, due to a harmonious abundance of yellow bile; (3) the phlegmatic temperament and its mucus harmonic potentials, and (4) the melancholic temperament due to the harmonic plus of black bile. The logic of the ancients ran a step further, and they recognized that every organism consisted of a greater or smaller number of parts (the organs and tissues) and that every part of the body possessed a definite, though not absolute, autonomy, in that the parts stood in certain relationships to each other. Every part had a specific significance and a recognizable influence on the other parts, and hippocratic physicians named this interrelationship of the whole to the parts the "constitution." This blending of morphologic and physiologic concepts should not be lost sight of. For the students of the 1880's diathesis is a grade stronger than temperament meaning a distinct proclivity toward some peculiar type of disease. Some diatheses are inherited and some are acquired, according to Hutchinson, following ancient precedents. Persistency is a necessary stigma. For dyscrasia this author goes a step further, for "dyscrasia" implies definite bad health—a chronic disease, if you will—whereas "diathesis" is only a damoclean sword. As for "idiosyncrasy," one is driven to regard it as some specific and inexplicably spontaneous disturbance—now so diligently cultivated by the "allergic" experimentalists in the biochemical field—threatening to rob the "psychic" arcanum of some of its brightest stars, for the time being at least, as the winds of doctrine blow hither and yon. For Hutchinson, "idiosyncrasy" was "individuality" run mad, or "diathesis" brought to a point.

Samuel Butler who, like Hering and later Richard Semon, was a strong advocate of mnemic inheritance, would undoubtedly claim that

what is called allergy at the present time is a pronounced form of chemical memory, and from the psychoanalytic discipline the numerous types of identification (called conditioned reflexes in the Russian terminology) might account for such allergic idiosyncrasies on rational grounds.

That temperament and character should have to be handed over to the more explicit psychic or conduct aspects of higher living organisms is quite understandable in view of the nebulous or intangible nature of the conceptions, even though according to Hutchinson a most striking genetic factor, such as the color of the skin and the complexion, should be discussed under temperamental features. Probably "red-headedness" and "temperament" will never be divorced in popular thinking. For the modern student Roback's masterly handling of the character-temperament problem is all-important. At all events the anthropologic salients, dating from the dim past when on Shakespeare's authority the Romans had their suspicions of "lean and hungry Cassius," lack the precise placing of the present day developments. Hutchinson collected a large number of accurate observations, even if they are roughly assorted semi-anthropologic material. It was excellent material for popular appeal. His was a great curiosity, and undoubtedly it led him away from complacent obscurantism in the medicine of his country, day and age. He was not one of those savants of whom Anatole France once wrote "*ils ne sont pas curieux*."

Garrod may be regarded as the present day bearer of the torch of the English clinicians from Walshe, Laycock and Hutchinson. He wrote: "It may even be justifiable to claim that what our fathers called diathesis is only another name for chemical individuality."

One could spend more time with this interesting series of observations on the "Pedigree of Disease," inscribed to the memory of Charles Darwin, from whose stimulating conceptions so much present day thought had its point of departure.

In mentioning Darwin's place in the scheme of evolution it must not be overlooked that such enduring key phrases, or, as one might say today such slogans, as "the survival of the fittest" and the "struggle for existence" came from Spencer in the indisputable aid that his all-embracing evolutionary vision gave to the more detailed and precise darwinian observations.

At the German Congress of Internal Medicine in 1911, when the subject of "diathesis" was the order of the day, His stated that when the conception of diathesis is again pushed into the foreground it is no fossil that one is uncovering. It is not the penchant for history that is operating, but the actual necessity for finding an expression for the inner important relationship of certain groups of diseases which by

reason of external expression and organic localizations have been dealt with as separate. It is an advance in the direction of etiologic clarity which has been so fruitful, but at the same time there are uncovered no new exogenic disease-producing agencies, only a clarification and sharper grasp of the individual or familial hereditary disease anlage.

Regarding His, mention of the constitutional conception—under the term of diathesis—as not being a resurrected fossil, one situation cannot be too strongly accented. This concerns the springtime flood of Virchow's cellular pathology wedded to the new discoveries streaming from the work of Pasteur, Koch and the bacteriologic laboratories, which buried the older "body as a unit," "*Ganzheit*" conceptions, much as the lava from Vesuvius once buried Herculaneum and Pompeii.

No historian could minimize the transcendent importance both of the newer organic conceptions of Virchow, now relegated to a more proportionate rôle in the advance, and of the great significance of the studies of exogenous energy systems with the resultant immunologic ontogenetic and phylogenetic possibilities of mutation inheritance. The historian can point out only that even at the spring-tide flow of these one-sided etiologic tendencies there were vigorous voices raised against their exclusive application. Hueppe, Rosenbach and Hansemann were among those who would stem the tide of the laval flow which followed the Pasteur-Virchow discoveries.

As Plato disembodied the soul and removed the anima from the body, thus devalizing the hippocratic-aristotelian conception, Virchow in his discussion of the old and new vitalism disembodied the organs. His *ens morbi* resided only in the cell; each organ became an independent abode for the new vitalism, and the "individual" fell into a thousand fragments. The fruit was abundant for the student of histologic morphology. With the marriage of bacteriology to cellular and organic pathology the "unity of the body" had no place. The ultraspecialism of the present day is the natural outcome of this accented salient, although, as Sigerist has recently emphasized, ultraspecialism flourished in Egypt in 500 B. C.

Neuburger's *Zur Geschichte der Konstitutionslehre* (1913) marks the end of an older era, as Martius, in 1914 marks the beginning of a new one. Neuburger alluded to the "decennial long" latency period during which the primacy of the Virchow anatomical-localization principle had led to one-sided etiologisms. Historically speaking, Neuburger's ten years might better be considered as fifty or even a hundred, since the crowd swings in exaggerated mass movements, as crowds always have a tendency to do.

Diepgen has sketched the speculative vitalistic pathology of the nineteenth century with rare historical insight. He also noted what has

always been observable, that even in the days when the Pasteur-Koch-Virchow conceptions were at their apogee there were some, von Leyden among others, who kept on the solid ground of clinical medicine and never lost sight of the whole picture, still holding fast to the Ariadne thread of truths that must still be conserved from the book of nature.

Neuburger said that such a history is still a desideratum if one is to avoid further methodologic errors which, while offering rich fruits, may still obscure more profitable efforts even for centuries.

The present sketch makes no pretense to go even as far as Neuburger did, as he himself spoke of the same difficulties in more erudite and polite phrases than the blunt ones of Bier's "noodle soup" and Jochen Nüsserl's dissertation on "leather" to which I shall presently refer.

In Martius one finds flat contradictions. For him the hippocratic conceptions are far too generalized to be of any service for modern students of constitution. To those whose glimpses of dwellers on Olympus are clearer, I leave the reception given to Martius by Hippocrates, Aristotle and the ancients.

"Opinions those and these"; thus Borchardt (p. 3) wrote that for him clinical necessities are of the greatest significance for the fundamental conceptions. Therefore he did not find Tandler's "condition conception," Bauer's "status degenerativus," or Bartels' "status hypoplasticus" satisfactory. Since both genetic and internal and external milieu factors are required, Borchardt would ally himself with Martius, Lubarsch, Pfaundler and Rössle. Heredity, while of outstanding significance for Borchardt, is not the only factor, any more than the abiotrophic (Gowers and the English school) or degenerative factors are unique.

At this time I cannot resist registering a puckian attitude toward the discords of opinions, those and these, as in the days of Empedocles. One sees mankind, as ever, urged toward the fantasy goal of certainty. Whether in linear extent of sticks or matches, in the opposed surface decisions of the flip of a coin, in the many estimates of what shall constitute the base or the sides of Pende's triangular pyramid, or the roll of six-sided eggs of Fatur Liva with its black dots 1 to 6—each in turn as an individual or in a group would find satisfaction in some aspect of certainty.

There are those who, piling Pelion on Ossa, go on a delirious jazz of ever increasing complexity, adding ball to ball, knife, plates, lamps, kitchen tables in their almost frantic prestidigitational endeavors to escape the cataclysm of the struggle with gravitational reality. The historian is as thunderstruck with the collection found in Bauer's classic as any yokel viewing the achievements of a prestidigitator.

It is no wonder, then, to hear the cry of the benevolent skeptic "back to Hippocrates"—and none louder than that of Bier, who found



in the naive and "schlichte" hippocratic "physis" everything that is needed—and of the moderns, "ein gelehrten Brei," a "noodle soup," says Puck.

"Nowhere," wrote Bier, protagonist of the Greeks as contrasted with the moderns, "is there any agreement. For one constitution is only inherited; for another it is born or acquired. For one it is always the same, unchangeable; according to another it is influenceable (conditioned). Now it is viewed solely from an anatomic point of view, again from a functional one, and still again from both. For this one it is a morphologic, for that, a physiologic, conception; for one a cellular, for another, a humoral, pathologic problem. The majority utilize many concepts. Many distinguish sharply between constitution and disposition; for others, as for Galen, the two terms mean the same. What one regards as a sign of degeneration, another considers a harmless variation." To any one who would convince himself of the incurable confusion Bier advises the reading of Hart's (1922) review. I have attempted it. It tells, with much else, that a history of the constitutional conception has never been written. Neuburger took a 'pot shot' at it in seven pages in 1913.

Bier claimed that the best picture of constitution is to be found in Fritz Reuter's "Stromtid." Here Jochen Nüssler said:

'Tis all so as dat Ledder is. Schaßsleder reisst aus, Rindsleder hält (Artskonstitution). Das Leder der rothen Gebirgsrassen des Rindviehs eignet sich besser zu Schuhen als das der bunten Niederungsrassen (Rassenkonstitution). Kalbsleder ist etwas anderes als Kuhleder (Alterskonstitution). Bullenleder wieder etwas anderes als Kuhleder (Geschlechtskonstitution). Ist das gleichartige Leder gut, so hält es viel, ist es schlecht, wenig aus (individuelle Konstitution). Das scheinbar beste Leder kann örtliche Fehler haben (*locus minoris resistentiae*). Diese Eigenschaften des Leders sind im grossem und ganzen vererbt (vererbte Konstitution), aber alles Leder, auch das beste muss gut behandelt werden, sonst wird es schimmelig oder brüchig und geht zu grunde. Auch das Leder von schlecht ernährten und schlecht gepflegten Tieren taugt nichts (erworbene Konstitution) u. s. w. Alles dies aber steht unter dem übergeordneten Begriffe. Leder mit seinem bestimmten Merkmalen (generelle Physis).

(It is the same as with leather. Sheep's leather tears; neat's leather holds [constitution of species]. The leather of the red mountain breeds of cattle is better suited for shoes than that of the dappled breeds of the lowlands [racial constitution]. Calf's leather is different from cow's leather [age constitution]. Leather from bulls is different from leather from cows [sex constitution]. Of the same leather, one may say that it is good, if it stands much; that it is bad, if it does not stand much [individual constitution]. Leather that is apparently perfect may have localized flaws [*locus minoris resistentiae*]. These qualities of leather are largely hereditary [hereditary constitution], but all leather, even the best, must be treated well, otherwise it becomes moldy or brittle and is destroyed. Leather from poorly fed and badly cared for animals is likewise not good [acquired constitution] and so on. All this, however, comes under the superordinated conception: leather with its characteristic attributes [general nature].)



Thus speaks naive realism, often thought of as common sense.

One can ascribe to Plato also the concept that disease is an autonomous something, a real thing, an "ontology" that enters the body and afflicts it. It is to be regretted that the laity still thinks of disease in some such conception—a thing to be exorcised, to be charmed, to be driven out by magic, by prayer, by injections of this or that drug. Even the most intelligent physician is helpless in combating this social ideology.

Plato was the spiritual father of the much quoted "ontology" conceptions with which medicine has had to battle throughout the centuries. Virchow sounded the tocsin anew in 1856, in stating that the conception of disease must be freed from its exceptional and ontologic significance, and yet within the next quarter of a century the etiologic researchers were completely on the old "ontologic" bandwagon, led by the triumphant bacteriologists, not altogether remote from the endocrinologic allergic enthusiasms of the present day.

This is neither the place nor the time to rehearse the old hippocratic tetrapod, octopod, humoral formulas of blood and mucus, yellow bile and black bile, and their warm and cold, wet and dry functional accompaniments, nor am I disposed to give much attention to their empedoclean, pythagorean or other problematic ancestry which came out of the primitive animistic past. Were this all that blazoned the periclean medical age, there might seem to be little through which this brilliant hellenic galaxy has illumined the path of medicine down through the ages.

For us the hippocratic conception of physis is that which contained the most germinal ideas, which finds its still growing application in the constitutional conceptions of the present day. Much as the historian might be tempted to enter into a discussion of this and the related dynamic conceptions of the even earlier homeric anima or spiritus, all that is of moment now is to recall that here is to be found the origin of the theory of vitalism as it has come down through the ages and of recent years has had to compete with the materialistic conceptions of the soma (inanima) which find so large a place in the inheritable gene factors so brilliantly exposed since the days of Mendel.

There is a legend that Plato would have liked to have burned all the works of Democritus, and Jacobi tells us of the parallel attitude of Goethe, the vitalist, toward Newton, the mechanist, a position not unknown at present in the relation of the "individualist" to the "geneticist."

And so to bed, lest I come under the onus of the many actual workers of my audience and deserve the judgment once spoken concerning Hannibal who, reaching Ephesus from Carthage, accepted an invitation to attend a disquisition by an aged philosopher on "How to Manage an

Army." At the close the delighted audience expectantly sought Hannibal's opinion: "Well," said he, "I have heard quite a number of crazy old men in my time, but never before such a doddering old idiot as this one."

Hippocrates, it is said, lived to be 109 years of age. No wonder his famous aphorism, "Art is long, life is short, the occasion fleeting, experience fallacious and judgment difficult," has lived through the ages.

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## HISTORY OF PERIPHERAL NEURITIS AS A CLINICAL ENTITY

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The subject of peripheral neuritis offers many difficulties to the medical historian. Even the disease itself is ill-defined, and many terms have been used to express the concept of a multiple, symmetrical neuritis, the result of various causes. For years, moreover, there was no adequate conception on the part of either clinician or pathologist as to the actual site of the disease. As far as can be ascertained, the English physician, Robert J. Graves,<sup>1</sup> was the first to point out that the disease "may be resident in the nervous cords themselves, or their extremities, which I shall call their *circumferential parts*." He came to this conclusion in a curious way, for it was based on his keen observation of some patients seen in Paris in 1828, at the time of an "epidemic" of neuritis which he observed with the French physician, Chomel.

Before Graves' time, however, others had described the clinical signs of certain types of neuritis without grasping the significance of its particular location. The most notable of such observations are those of John C. Lettsom and James Jackson on neuritis caused by or associated with alcoholism and deficiency of food. Lettsom's paper<sup>2</sup> was read at a meeting of the Medical Society of London on April 3, 1786, and was published the next year. Buried as it is in an article on what appears to be a totally unrelated subject, namely, the materia medica of the drug *lignum quassiae amarae*, the striking contribution of this keen observer was unrecognized for many years. *Quassia* (bitter wood) was often used in Lettsom's time as a stomachic and febrifuge. It is in this relation that Lettsom referred to alcoholic neuritis:<sup>3</sup>

After introducing dyspepsia arising from the indulgence of drinking, I cannot well dismiss the subject, without adverting more fully to its painful influence upon the constitution, which I have observed with more anxiety, as the sufferers are often those of the more delicate part of the female sex, whose habits of intemperance are not unfrequently introduced by those who should have been the guardians of their health.

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1. Graves, Robert J.: *Clinical Lectures on the Practice of Medicine* (edited by J. M. Neligan), ed. 2, Dublin, Fannin & Co., 1848.

2. Lettsom, John C.: *Some Remarks on the Effects of Lignum Quassiae Amarae*, *Mem. M. Soc. London* 1:128, 1787.

3. Lettsom,<sup>2</sup> p. 151.

He then noted the principal symptoms, the first of which is dyspepsia, the second, pain and oppression of the precordia and the third, the neuritis, which he described as follows:<sup>4</sup>

The lower extremities grow more and more emaciated; the legs become as smooth as polished ivory, and the soles of the feet even glassy and shining, and at the same time so tender, that the weight of the finger excites shrieks and moaning; and yet I have known, that in a moment's time, heavy pressure has given no uneasiness. The legs, and the whole lower extremities, lose all power of action; wherever they are placed, there they remain till moved again by the attendant; the arms and hands acquire the same paralysis, and render the patients incapable of feeding themselves. Thus, for years they exist, with no material alteration in the size of the body, or aspect of the countenance. Whether they really undergo the agonies they appear to suffer, I much doubt, as at this period their minds appear idiotish: they often shriek out with a vehemence that may be heard at a considerable distance, but upon inquiring about the seat of the pain, they have been vague and indecisive in their answers. When a cramp comes on the lower extremities, involuntary motions draw up the legs, and produce the most piercing shrieks: and the features of the face, altered by convulsive twitching, excite pain in a spectator. For some months before they die, these shrieks are more incessant, and as violent as the strength will admit.

No one could describe in better terms the appearance and the sensitiveness of the lower extremities, "as smooth as polished ivory, and the soles of the feet even glassy and shining, and at the same time so tender that the weight of the finger excites shrieks and moaning." He noted also the paralysis of the arms and legs, the mental symptoms, the cramps and the withdrawal reflex of the legs, as well as the more general symptoms of dyspepsia and precordial oppression. Lettsom knew nothing of the pathologic process of the disease, and it is not even clear that he sensed its location. In spite of the fact that he did not use the term neuritis he clearly described the alcoholic form, and his vivid words stand out today as strikingly as they did in the late eighteenth century.

Lettsom's classic but brief description of alcoholic neuritis was greatly augmented, thirty-five years later, by an early paper by James Jackson<sup>5</sup> from the Massachusetts General Hospital in Boston, which was opened in September 1821. He knew of no previous writing on the subject. Several instances had come to his attention, mostly in women, of a condition which he called "arthrodynia à potu," and his description affords a striking picture of the disease. He wrote:

This arthrodynia comes on gradually. It commences with pains in the lower limbs, but especially in the feet; and afterwards extends to the hands and arms. The hands may be affected first in some instances; and in all cases in an advanced state, the pain is more severe in the feet and hands, than in the upper parts of the

4. Lettsom,<sup>2</sup> p. 160.

5. Jackson, James: On a Peculiar Disease Resulting from the Use of Ardent Spirits, *New England J. Med. & Surg.* **11**:351, 1822. This article was first published in abstract in Address of the Trustees of the Massachusetts General Hospital, to the Subscribers and to the Public, March 6, 1822, p. 10.



limbs. The pain is excruciating, but varies in degree at different times. It is accompanied by a distressing feeling of numbness. After the disease has continued a short time, there takes place some contraction of the fingers and toes, and an inability to use these parts freely. At length the hands and feet become nearly useless, the flexor muscles manifesting, as in other diseases, greater power than the extensors. The whole body is diminished in size, unless it be the abdomen, but the face does not exhibit the appearance of emaciation common to many visceral diseases. This diminution is especially observable in the feet and hands; and at the same time the skin of these parts acquires a peculiar appearance. The same appearance is sometimes noticed, in a slighter degree, in the skin of other parts. This appearance consists in a great smoothness and shining, with a sort of fineness of the skin. The integuments look as if tight and stretched without rugae or wrinkles; somewhat as when the subjacent parts are swollen; but the skin is not discolored. . . . The most characteristic symptoms of this disease are manifested in the limbs; but the pain is not limited to these, and other symptoms are exhibited in other parts. The pain sometimes shoots suddenly up one or both legs, and in one case it frequently passed up the back and then forward to the pit of the stomach, taking the course of the diaphragm. The functions of the stomach are always impaired and generally very much. The appetite is lost, or is morbid, the patient craving only the most powerful stimulants; the food is often rejected, and constipation or diarrhoea takes place. The mind is weakened; but it is free from delirium ordinarily, and is alive to the horrible sufferings of the disease. Sleep is prevented by pain and is procured only by opiates.

Thus Jackson added to Lettsom's observation the note that the hands may be first affected, that contractions occur and that constipation, diarrhea and insomnia are frequent symptoms. He believed that the disease was caused by the excessive use of "ardent spirits" and that unless liquor was abandoned the condition was usually fatal. Because of the marked changes in the skin and the dissimilarity of the paralysis to ordinary paralytic involvement, Jackson thought the disease due to lesions in the skin and muscles and not in the nerves. Without study of the pathologic processes, therefore, he failed to localize the disease correctly as peripheral neuritis. Jackson's contribution did not have wide circulation. It was forgotten for many years, as was Lettsom's. Further light on the problem of neuritis came from a different quarter in an unexpected form.

In 1828 there occurred a curious epidemic in Paris, first noted in the spring, at the Marie-Thérèse Infirmary. Subsequently it spread to all parts of Paris, but was especially severe in areas in which the population was dense and the people in poor circumstances. A description of both the epidemiology and the symptomatology of the disease was given by Auguste-François Chomel.<sup>6</sup> The epidemic was so extensive that at the Charité, where Chomel observed his cases, nearly a

6. Chomel, A.-F.: *De l'épidémie actuellement régnante à Paris*, J. hebd. de méd. 1:333 (Nov. 29) 1828.

quarter of the beds were occupied by patients with this disease. The chief symptom, as described by Chomel, was pain in the feet and hands,<sup>7</sup>

. . . more acute at night than during the day, and intensified by pressure. At times those afflicted cannot wear shoes and from choice use sabots or cloth slippers in which their feet can be comfortable. The pain seems to be in the skin, but, it must be stated, it is in no way in keeping with the apparent structural changes noted; and while inflammation of the tissue is seen in some cases, in others who suffer intense pain the skin seems to be in a most normal condition. When asked concerning this pain, the patients compare it to a sensation of crawling ants, stating that when they walk there is a sensation as if they were walking on needles, which causes them to cry out.

One patient could not bear the slightest pressure on his hand, the pain being so acute that he immediately had to drop anything he wanted to pick up. He always wore gloves and socks, for otherwise it would be impossible for him to hold a knife or bear the weight of the covers on his feet. Chomel wrote:

Other disturbances of sensation are also present with these phenomena, but differ somewhat from the foregoing and usually occur later. These include a numbing and deadening of the sense of touch, which is sometimes very marked. Several patients exhibit an inability to distinguish one object from another by touch—a key from a pair of scissors, for example—and are completely deceived. In others the sole of the foot is insensible to cold, with the result that when such patients' shoes fall off, as often happens, they continue walking without realizing that they are directly on the pavement. Still others, in ascending a staircase, have a sensation of it giving beneath them, as if made of some soft substance. Their movements are also constantly altered in varying degrees. Most common is the inability to flex or extend the fingers entirely, the action being restrained by a sensation similar to that of a first degree burn. These patients are unable to grasp an object or fasten a button. The same condition exists in their feet. Their gait develops peculiar characteristics; the foot put down flat on the ground does not grip at all, and must be lifted like an inert mass, the toes constantly dragging. This results in great slowness and difficulty in walking. Some walk with the legs apart. But these disorders of muscular contraction at times develop much further. Some patients lose entirely the ability to move, and lie stretched out in bed with their arms beside their body. The limb, when lifted, falls back as soon as released; the wrist hangs loosely at the end of the forearm, the fingers pendant from the carpals and the toes as if bent. At times they feel the most acute pain in their limbs, with resultant shaking and trembling; but the shaking is purely instinctive and not at all convulsive. These are the phenomena exhibited by all patients but, naturally, in different degrees in each case and in each part of the body. Thus one hand is sometimes affected more than the other, or a foot more than the hands. In this respect great variety exists.

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7. In translations into English an attempt has been made to secure the correct meaning of phrases, but in some instances this is not entirely possible. Considerable liberty has been taken in omitting parts of the original text for the sake of clarity and to shorten the quotation.

Chomel also noted the erythema of the hands and feet, which he thought to be due to "a special inflammation of the skin." He described the copious sweating of the parts, the formation of blisters and actual desquamation. In some cases the epidermis, reflected from the pulp of the finger under the surface of the nail, swelled, thickened and formed a cushion which, continuing with the nail, gave the finger-tip an elongated and attenuated form, with resultant sensitiveness and even pain. Another result, the opposite of the preceding, was "a softness, a remarkable smoothness in the skin of the pulp of the fingers, the skin appearing finer and smoother than under normal conditions and much finer than that of women least likely to use their fingers in manual labor."

Some other symptoms, more general in character, that were observed in this epidemic lead one to believe that the disease was a toxic condition of the whole body, with the most marked manifestation in the peripheral nerves. The disease today would probably be classed as infectious neuritis; it progressed by remissions and recrudescences, and was not particularly serious, although several deaths occurred from respiratory failure. Although in one fatal case, P.-C.-A. Louis, who was a pupil of Chomel, performed the postmortem examination "with all the care and skill for which he is known," nothing was found to explain the patient's death, and the cause of the paralysis was not revealed. The spinal cord was examined and "the nerves dissected and followed to the finger-tips and toes." In a second case examination gave similar results. In spite of these negative findings it should be noted that Chomel, at least, had supposedly localized the disease to either the spinal cord or the peripheral nerves. So far as is known this is the first instance in which a suggestion was made that the nerves might be the seat of the lesion.

If Chomel, in his brilliant clinical description, failed to place the entire responsibility for the disease on the peripheral nerves, another observer did not. Graves,<sup>1</sup> writing of the same epidemic, but not publishing his account until 1843 when the first edition of his "Clinical Lectures" appeared, said:

One of the most remarkable examples of disease of the nervous system, commencing in the extremities, and having no connexion with lesions of the brain, or spinal marrow, was the curious *épidémie de Paris*, which occurred in the spring of 1828. Chomel has described this epidemic in the *Journal Hebdomadaire*,<sup>6</sup> and having witnessed it myself, in the months of July and August, of the same year, I can bear testimony to the ability and accuracy of his description. It began (frequently in persons of good constitution) with sensations of pricking and severe pain in the integuments of the hands and feet, accompanied by so acute a degree of sensibility, that the patients could not bear these parts to be touched by the bed-clothes. After some time, a few days, or even a few hours, a diminution, or even abolition of sensation took place in the affected members, they became incapable of distinguishing the shape, texture, or temperature of bodies, the power of

motion declined, and finally they were observed to become altogether paralytic. The injury was not confined to the hands and feet alone, but advancing, with progressive pace, extended over the whole of both extremities. Persons lay in bed powerless and helpless, and continued in this state for weeks and even months.

He reported that "the French pathologists searched anxiously in the nervous centers for the cause of this strange disorder, but could find none; there was no evident lesion, functional or organic, discoverable in the brain, cerebellum, or spinal marrow." Graves concluded that the disease probably was in the peripheral nerves, thus, ninety years ago, laying the foundations for the modern conception of neuritis. The importance of Graves' contribution to the history of neuritis was completely overlooked until 1866, when Louis Duménil called attention to Graves' theory.<sup>8</sup>

Five years after Chomel's notation of the Paris epidemic, C.-P. Ollivier,<sup>9</sup> of Bordeaux, described the symptoms of two patients, each with what would now be classified as Landry's paralysis, although this was twenty-five years before Landry's classic paper. Both were thought by Ollivier to be examples of disease of the spinal cord.

The first patient, a servant girl, aged 31, suffered a generalized paralysis, April 1, 1825, about a month after the normal termination of a pregnancy. She died in two days and at a postmortem examination the brain and spinal cord were found to be normal, except for some congestion of the membranes.

This is regarded as the first reported case of Landry's paralysis.<sup>8</sup>

A second patient,<sup>10</sup> a sea captain, aged 41, in May 1833, "went sailing on the Garonne for three or four hours, one rather cool evening. That night his step was slow and awkward. The next morning on attempting to arise, he fell heavily from the bed to the floor, dragged himself to a window, which he could not open, and, when help was brought by his shouts, was put back in bed. He could still make some slight movements. . . . He lost entirely the power of abdominal and thoracic movement and, shortly after that, of the lower three-fourths of the spinal column. His head could only be moved from right to left and vice versa. The greater part of the inspiratory muscles became inert; coughing was difficult, expectoration impossible." The patient recovered slowly and by February 1834, could move in bed and sign letters.<sup>11</sup>

Thus Ollivier, who added so much to the knowledge of disease of the spinal cord by his work, beginning with his Paris thesis on the subject in 1823 and culminating in his textbook in two volumes in 1837, was confused by the negative postmortem findings in his first case. He

8. Ross, James, and Bury, Judson S.: *On Peripheral Neuritis*, London, C. Griffin & Co., 1893.

9. Ollivier, C.-P.: *Traité des maladies de la moelle épinière*, ed. 3, Paris, Megnignon-Marvis, 1837, vol. 2 (case LXXIV, p. 51).

10. Ollivier,<sup>9</sup> case 77, p. 73.

11. A preliminary note (not verified) was published in the *Bulletin médical de Bordeaux*, 1834.

did not, moreover, seem to have noted the resemblance of the condition of the Bordeaux sea captain to the cases described by Chomel. His work, although of interest historically, did not advance the subject, and was overshadowed by Landry's publication of 1859.

The next contribution to the history of neuritis, chronologically, came from Stockholm.<sup>12</sup> Magnus Huss<sup>13</sup> had long been interested in the effects of the excessive use of alcohol. His extensive research was published from 1849 to 1851, and in it are to be found notes on the various types of nervous manifestations in cases of chronic alcoholism. He divided his cases into various forms, namely, paralytic, anesthetic, convulsive, epileptic and hyperesthetic. His case 5<sup>14</sup> may be taken as a typical example of the paralytic form. A man, aged 33, with chronic gastritis, enlargement of the liver and delirium tremens, became partially paralyzed in all the extremities, with tremor. Fornication was marked. Huss knew of Lettsom's description, but not of Jackson's. He did not implicate the peripheral nerves as the site of the lesion.

A little later, in 1855, Duchenne,<sup>15</sup> of Boulogne, published his work on the use of electricity in the diagnosis and treatment of nervous diseases, the results of the observation of many patients. In spite of the reports on 217 cases, there is no clearcut case of generalized neuritis. Perhaps the one most closely associated with this disease is his case 102.<sup>16</sup> Although a case of progressive paralysis of the extremities, it also showed bulbar involvement and an absence of sensory symptoms.

The patient, a man, aged 55, first noticed a disorder of speech while on a trip to California in 1849. On returning to France in 1850, there developed weakness of the legs, without pain or sensory symptoms. When seen by Duchenne in March, 1852, there were a right facial paralysis, marked hypoglossal palsy and paralysis of the limbs. There was no loss of intellect. Sphincteric weakness, a bed sore and death followed.

On observing the lack of mental impairment, Duchenne was naturally interested in comparing the patient's condition with dementia paralytica. The normal reaction of the muscles to electricity did not help him in the differential diagnosis, but the lack of mental symptoms led him to the conclusion that the patient was not suffering from that disease. In

12. This statement may be questioned, as the work of Brühl-Cramer, "Ueber die Trunksucht und eine rationelle Heilmethode derselben," Berlin, 1819, has not been examined. He was a practicing physician in Moscow and is said to have observed alcoholic paralysis, with sensory and vasomotor disorders (Ross and Bury,<sup>8</sup> p. 123).

13. Huss, Magnus: *Alcoholismus chronicus eller chronisk alkoholssjukdom* (2 vols.), Stockholm, J. Beckman, 1849-1851.

14. Huss, Magnus: *Chronische Alkoholskrankheit oder Alcoholismus chronicus*, translated by Gerhard van dem Busch, Stockholm and Leipzig, C. E. Fritze, 1852.

15. Duchenne de Boulogne: *De l'électrisation localisée*, Paris, J. B. Bailliére & fils, 1885.

16. Duchenne de Boulogne,<sup>15</sup> p. 610.



addition, there were the normal findings post mortem. Duchenne thought that the case was "exceptional," but could offer no explanation for the findings. Even in the third edition of his book<sup>17</sup> he still classified the condition as subacute general spinal paralysis, and localized the lesion principally in the anterior horns, with a diffuse secondary invasion of the whole spinal cord.

With Landry,<sup>18</sup> however, who published his first article in 1859, one comes to something more definite. Using Ollivier's work as a basis he described the acute or rapidly progressive type of paralysis, usually ascending in form. His description is so clear that it seems worth while to give it in full, omitting only certain references to the form of treatment used and the detailed postmortem findings.

The patient, a man, aged 43, entered the Beaujon Hospital on June 1, 1859. There had been many premonitory symptoms, during the previous year and a half, including periods of fever, general indisposition, chills, pain in the extremities, easy fatigue, difficulty in swallowing and tingling in the fingers and toes, without actual paralysis. He was able, nevertheless, to walk without difficulty from Boulogne-sur-Seine to the Beaujon Hospital, on June 1, and no appreciable symptoms appeared until June 13. Dr. Gubler, on whose service he was, found nothing to confirm the patient's complaint of general weakness, and rather doubted the man's sincerity.

The patient, as described by Landry two weeks after admission, "noticed that his knees often gave way while walking. The next day this weakness became more frequent, and his feet seemed heavy, as if fastened to the ground and difficult to raise. For some days past the tingling sensation had spread through his feet and gradually to his legs and thighs and to his arms. The sensation advanced upward, forming, as it were, a tight band around the affected parts, and, as it spread, leaving the limbs numb as from cold. During the following days walking became more and more difficult. The patient could not lift his legs. His progress was slow and possible only by dragging his foot on the ground. On June 17 the patient claimed he could not walk or stand up. He was made to stand supported by 2 people, and it was evident that his lower limbs gave way as soon as weight was placed on them. When he tried to walk, his movements were slow and heavy and not abrupt and irregular. His feet did not leave the floor, and instead of being quickly and jerkily thrown forward, scraped as though they were dragged along. In bed he was unable to raise either leg from the mattress. It was difficult for him to bend his thighs. Lying on his back he tried in vain to turn on one side; but while his trunk moved easily enough, he could not carry the pelvis with it. There was little change in the movement of his upper limbs. He had sufficient strength in his fingers and hands to grab and hold onto those helping him to walk when they pretended to let go of him. He complained, however, of a certain stiffness in his fingers, which felt swollen or as if surrounded and squeezed, 'tied' by cords, when he wanted to bend them. For some days he had the same sensation in his toes when he moved them. These sensations, however, were felt only from spontaneous movements and not from passive ones; his articulation was in no

17. Duchenne de Boulogne,<sup>15</sup> ed. 3, Paris, 1872.

18. Landry, Octave: Note sur la paralysie ascendante aiguë, *Gaz. hebdomadaire de médecine*, 6:472 (July 29) and 486 (Aug. 5) 1859.



way abnormal and the paralyzed parts were supple. Movements involving the raising of the arms were the only ones visibly affected so far as the shoulders were concerned. He could not raise his arms to a horizontal position, or hold them there when they were so placed. This was especially noticeable in the right arm. There was no fever, no pain either in the limbs or along the vertebral axis, no headache, no contraction, no convulsive or reflex movements when efforts were made to produce them. Feeling was somewhat deadened on the soles of the feet only. The intelligence was normal." Even at this time Dr. Gubler was still afraid of some deceit.

By June 20, however, Landry noted that "the motor paralysis continues to increase in the parts already affected and to spread to those hitherto untouched. Today it is almost complete in the lower limbs. The upper limbs have been of no use to the patient since yesterday, although they have not lost their power of movement entirely. The tingling sensation, which has continued to climb, is now felt in the thorax and at the base of the neck. The patient complains of a slight difficulty in respiration, a sort of painful constriction of the thorax; he also speaks of an 'obstruction' in the epigastrium which impedes inhalation. On examining his chest the ribs are found to be raised, and their individual movements greatly restricted. Moreover, the epigastrium sinks slightly during inspiration and rises with expiration. This is very pronounced when the patient is lying on his back, but hardly noticeable when he is sitting up. He can still exert himself, and when he makes the effort, the epigastrium is seen to distend as in the normal state. There is a slight dyspnea; speech is somewhat broken, and expectoration weak. The patient also claims that his tongue feels thick and less mobile; his jaw seems heavier, and food appears harder than usual; there is also a slight dysphagia."

The next day Landry made a more detailed examination, which he described as follows: "*Lower limbs.*—Power of movement in these limbs as a whole is very slight. However hard the patient tries he cannot raise them above the plane in which they lie. The only muscular contraction noticeable in these attempts are those of the quadriceps extensor. Motility of each segment is as follows: movement of the toes and feet is entirely lost, and despite all efforts, the patient cannot contract the leg muscles to the slightest degree. If the thigh is elevated, the patient can extend his leg and keep it thus extended for some little time, but with the slightest pressure, it gives, bends, and drops like an inert body. Even in supporting the leg to lighten its weight there is no movement of the thigh about the pelvis. Flexion, adduction, abduction, extension and rotation are entirely lacking. However, during the patient's efforts, contraction can be seen and felt with the hand in the adductor muscles, but nothing of the sort in the muscles of the buttocks. On the whole, paralysis is less complete in the anterior and internal muscles of the thigh than in those dependent on the sciatic nerve for their motivation. *Upper limbs.*—General movement of the upper limbs is greatly restricted; abduction and elevation of the arm are entirely impossible. If it is placed at right angles on the shoulder it drops immediately, the patient being unable to check or retard its fall. However, the deltoid muscle can be seen and felt to contract, although obviously insufficiently. Rotation of the arm in either direction is loose and incomplete. Elsewhere paralysis seems less complete, but always in proportion to the distance from its base. Spreading of the fingers is vaguely indicated by certain quivering motions; adduction and opposition of the thumb are almost nil; the fingers are half flexed and the patient can increase the flexion only slightly; neither can he grasp nor hold objects placed in his hand. Extension of the fingers and wrists is almost impossible; lateral or rotary movement of the hand is greatly

restricted. The patient can bend and extend the left forearm with little difficulty, but the slightest resistance is sufficient to prevent it. The same movements are weaker and much more restricted in the right arm. *Trunk, etc.*—A sitting position is impossible, and when the patient is so placed he cannot hold it unless supported, but falls backward or to one side. The abdominal muscles contract voluntarily, but weakly. The walls of the thorax rise simultaneously during inspiration, by the action of the cervical muscles alone, and the intercostal spaces show no apparent variation. The trapezium and the pectoral muscles still contract satisfactorily, and the patient can move his shoulder forward, backward, or upward without difficulty; a slight effort on my part, however, prevents all these movements. During these movements, or when the patient breathes deeply, the serratus magnus does not appear to function at all. The scapula, moreover, keeps its normal position. If the patient is made to sit up, his head falls forward or to one side and is raised only with difficulty. The diaphragm is evidently affected by the paralysis, for with inspiration, especially when deep, the epigastrium sinks noticeably and rises with expiration. He can still exert himself, but for a very short period, after which he is exhausted and out of breath. Sphincteric weakness developed. The electric reactions of the muscles and nerves were normal. There were no tremors, and the muscles were not atrophied. Reflexes were abolished."

"Feeling," continued Landry, "is much less affected than motion. Perception of pain and temperature has not changed, while that of muscular activity, although retained throughout almost the whole body, has been lost in the motor muscles of the feet and toes. In fact, he is not aware of movements imparted to these parts or of contractions of the muscles when electricity is applied. However, he feels the pain of cramps readily and the cutaneous pain from the excitant just mentioned. Moreover, the sensation of muscular activity exists throughout, and is not even diminished. Simple contacts with bodies at any temperature are not felt on the soles or back of the feet. At the height of the lower third of the legs the patient begins to feel such impressions vaguely, and they become more and more distinct as they ascend toward the trunk. In the upper parts the anesthesia does not extend beyond the lower third of the forearm, and is complete only in the fleshy part of the fingers. Sensitiveness to contact is dulled in the posterior and lateral sections of the trunk. He realizes when these parts are touched, but can perceive no difference between a simple touch and the rubbing of the skin, between the contact of the hand and that of a woolen cloth passed over the body. There also, as elsewhere, where the anesthesia is not especially pronounced, he perceives a firm touch or contact and not the light impression produced by stroking the skin with the tip of the finger or with a feather. In the paralyzed parts, especially at his extremities, the patient complains of a feeling of torpor or numbness comparable to the effect of intense cold; he also states that these parts are always cold. And in fact they evidently are, although well covered, and despite the high seasonal temperature and the rapidity of the pulse (85 to 90 beats); the feet especially have the temperature of a corpse. The individual senses are all normal. The patient's intelligence, naturally not greatly developed, has not changed. Today it even seemed that his replies were clearer and more concise, with more thought to selection and propriety in his expression. This, to be sure, may be due to less timidity than in the preceding days. His general condition presents nothing alarming; the physiognomy of the patient is very calm, and at the first glance the dyspnea of which he complains can scarcely be noticed. However, he expresses some fear concerning his condition and at times he seems to feel gloomy misgiv-

ings." The patient died suddenly on the same day after being placed in a sitting position. The whole course of the disease was eight days after the onset of the paralysis.

Postmortem examination showed no alterations in either the brain or the spinal cord. The muscles were also normal in appearance. The microscopic sections were studied by Bourguignon, Gubler and Charles Robin, as well as by Landry. The peripheral nerves, however, were not examined. Landry stated that he observed 4 other similar cases and found reports of 5 more in the literature, including those described by Ollivier. Of the 10 cases, only 2 were fatal. The return of function in the cases of recovery was in the reverse order of that noted in the onset.

The article is one of the outstanding contributions to neurology. A clear picture is drawn of acute ascending paralysis, largely but not entirely motor in type, which ends in respiratory paralysis and death or recovery takes place with a disappearance of the disease. Recurrence was recognized. The congestion of the membranes found in Ollivier's study of the pathologic changes was not considered a sufficient cause of death by Landry, and he was forced to classify his case as "so-called essential paralysis," without known cause. He did not seem to be familiar with Graves' suggestion of peripheral neuritis as the cause of a somewhat similar disease.

That Landry's paralysis was an acute form of multiple neuritis, or that widespread paralysis of any form could be the result of a lesion in the peripheral nerves was not clearly established until 1864, when Louis Duménil, of Rouen, published his article in which the site of the disease was verified by pathologic examination. His reports, so long neglected by medical historians, placed multiple neuritis on a sure footing, and Duménil should be given credit for establishing the disease on a foundation of certainty.

Duménil's <sup>19</sup> first patient, a man, aged 71, entered the Rouen General Hospital in June 1862. "A tingling sensation," wrote Duménil in describing the present illness, "which he felt in his toes for some two weeks, was followed on July 20 by numbness in the left foot and right arm. A few days later the left arm was similarly affected. There was no headache or pain. On August 14 the attendant stated that when the patient was taken out of bed, his two feet swung as if lifeless. We had noticed, in fact, on August 18, that the two feet were entirely motionless when extended, as if left to their natural weight. All passive movements could be imparted to them with the greatest ease, but the patient was unable to give any active movement to his feet or toes. Immobility was equally complete on both sides. All movements of the legs on the thighs and the thighs on the trunk were executed normally with a degree of energy compatible with the underdeveloped muscular system. On the same day we also noted an insensibility to pin-pricks in the lower half of the external region of the right leg and the lower part of the

19. Duménil, Louis: Paralyse périphérique du mouvement et du sentiment portant sur les quatre membres. Atrophie des rameaux nerveux des parties paralysées, *Gaz. hebdomadaire de médecine*. 1:203 (March 25) 1864.

inside of the leg. Feeling was very slight on the sole of the foot. There was also a lack of feeling in the lower quarter of the outer region of the leg and foot; but not in the inner part. Movements of the hands and fingers were very restricted—on the right side more than the left—and he could grasp nothing, not even a hand extended to him. Movements of the forearm on the arm and of the arm on the shoulder were normal.

"On September 6 a careful examination of the patient showed the following: *Left arm.*—All movements of the arm on the shoulder and the forearm on the arm were normal. The hand could move on the forearm, but with little strength; flexion and extension of the fingers were also possible, but with still less force. The patient could only close his hand very feebly; complete flexion of the fingers could be accomplished only by throwing the wrist back forcibly, which the patient did instinctively when asked to bend his fingers. Extension of the fingers was normal; the thumb retained all its movements; the fingers could not be separated from each other; and adduction of the index finger only was possible to a slight degree. The palmar surface of the entire little finger and the inner half of the ring finger were insensible to pin-prick, and this insensibility extended to the root of the fingers. Feeling recurred on the inner edge of the hand along a well marked line, but by degrees and not suddenly. The dorsal portion of the little finger and of the inner half of the ring finger was insensible, and the insensibility continued into the back of the hand as far as the region of the carpometacarpal joints. The patient had a clear perception of the form and temperature of a metal sphere placed in his hand while his eyes were closed. *Right arm.*—All movements of the arm on the shoulder and the forearm on the arm could be executed. Pronation was impossible. Flexion and extension of the wrist were very limited—more so than on the other side; adduction and abduction were possible to a slight degree. Flexion and extension of the fingers were almost impossible. Opposition of the thumb had completely disappeared, and without application of force it could only be drawn up to the index finger in the general plane of the metacarpal bones. This movement was so feeble that the patient was unable to hold a handkerchief. The little finger and the inner half of the ring finger retained their sensitiveness, but this was lost or considerably diminished, although unequally, in the palmar surface of the other fingers of this hand. The muscles of the arms were greatly atrophied, but uniformly so. This atrophy was particularly noticeable in the forearm and hands. The thenar eminences had almost entirely disappeared. The deltoid muscles formed a thin layer attached to the scapulohumeral articulation. *Lower limbs.*—These were atrophied; the calves were flabby. The leg movements on the thighs and the thighs on the trunk were well executed, but the feet and the toes were absolutely immobile. Insensibility to pin-pricks was complete on the dorsal surface of all the toes, and extended irregularly over the dorsal surface of the metatarsus and tarsus, being prolonged over the tarsus at certain points, and ceasing at the base of the toes at other points. Insensibility was likewise general and complete on the plantar surface of the toes, spreading irregularly to the soles of the feet. It also ascended the outer side of both legs, but higher on the right than on the left." Electrical stimulation failed to give a response to faradism in many of the muscles of the arms, especially those of the hands, and in all the muscles of the legs except those in the anterior part of the thigh.

The patient died of pneumonia five months after entrance to the hospital, without further extension of the paralysis. Postmortem examination revealed the muscles diminished in volume, but without fatty infiltration, and only slightly lacking in their normal color. The brain, spinal cord and nerve roots, examined with

great care, showed no abnormality. The peripheral nerves, grossly, did not appear abnormal, but on microscopic examination, which was carried out in great detail, Georges Ponchet found well marked changes. "A true atrophy of the medullary substance of the peripheral nerve tubes" was found in the affected nerves, involving both the muscular and cutaneous branches, while nerves to muscles and parts of the body not paralyzed by the disease were described as normal.

In reading over Duménil's striking contribution one is impressed with his careful clinical observation and his detailed studies of the pathologic process. No one before him had given such a clear explanation of peripheral neuritis. Before his time, with the exception of the rather casual note by Graves, all investigators had centered their interest on the spinal cord or brain. Dementia paralytica was common and obviously a disease of the brain. Paralysis was one of its later manifestations. It is natural that physicians thought, before the work of Duménil, that the essential lesions must be in the brain or spinal cord in all cases of paralysis. Even Landry had failed to examine the peripheral nerves. Duménil was, no doubt, led to his discovery by the work of Charcot and Vulpian on palatal paralysis in diphtheria, published only two years before. That he took advantage of it is greatly to his credit. He was a pioneer<sup>20</sup> in a special field of neurology, who, by methodical and precise investigation, added greatly to the knowledge of the subject.

Duménil expanded the subject, and used for the first time the term chronic neuritis in another article published two years later.<sup>21</sup>

Of the 3 cases reported, the first was that of a woman, aged 36, who was seen in August 1860. She first had sciatica on the right side, followed by generalized neuritis. Duménil noted, in the course of the illness, which lasted until July 1865, the progressive involvement of the extremities with paresthesia, pain and paralysis, until death occurred. There were many detailed examinations characteristic of his careful work. Although nothing new was added to the literature by this case, it forms an excellent clinical description of the disease, and death from respiratory paralysis is clearly depicted. No postmortem examination was made. The second patient, a man, aged 64, was seen at the Rouen General Hospital in December 1864. The course of the disease was more rapid than in the first case, for paralysis was well established in three months. Duménil's description of the right hand is worthy of quotation: "In the right forearm there was some emaciation, particularly in the muscles of the anterior and external regions, which had completely lost their outline, the flesh being flabby. The muscles of the anterior region exhibited an exaggerated tension, especially the palmaris longus, the tendon of which formed beneath the skin a projecting cord which stretched considerably with forced extension of the forearm. At the same time as this emaciation appeared in the

20. Halipré, A.: Louis Duménil (1823-1890), *Rev. méd. de Normandie* **1**:195, 1900.

21. Duménil, Louis: Contributions pour servir à l'histoire des paralysies périphériques, et spécialement de la névrite, *Gaz. hebd. de méd.* **3**:51 (Jan. 26), 67 (Feb. 2) and 84 (Feb. 9) 1866.



muscles we noticed remarkable changes in the skin and articulations. In the right hand the phalangeal articulations were swollen, but without redness. The fingers were slightly flexed at these articulations, more or less in the form of a quarter-circle. Not only was voluntary extension impossible, but passive extension met with an insurmountable resistance which did not come from the retraction of the flexor muscles, in which no increased tension could be felt. This resistance evidently had to do with the condition of the articulations. On the left hand the articulations of the fingers exhibited the same stiffness, but without tumefaction. The fingers on this side had a fusiform appearance and were, so to speak, all of a size. The skin was without wrinkles, smooth and shining. The patient complained of pains in the articulations of the phalanges and wrists; pressure and passive movements were painful in those parts."

This is reminiscent of Lettsom; no one between these two good observers had drawn such a clear picture of the changes in the skin and joints. The hyperesthesia, too, was noted with care: "The patient felt sudden sharp pains on the soles of the feet and palms of the hands; pressure on the substance of the fingers was slightly painful. He also began to complain of sensitiveness to the contact of objects with the palms of his hands; the objects that he touched seemed rough and uneven. This type of hyperesthesia increased gradually. The slightest pressure on the substance of the fingers and their whole palmar surface, as well as on the palm of the hand, and simple contact of a pin-point on the same parts caused sharp pains. Sensitiveness was also exaggerated on the dorsal surface of the fingers and hands, but less than on the palmar surface. The hyperesthesia existed in the same degree in all parts of both hands, as well as on the plantar surface of the toes and feet." Recovery took place slowly, beginning about six months after the onset, and by the end of the year was nearly complete. A third case, of less severity, with more rapid recovery, was also reported by Duménil in the same paper.

In the discussion which follows the paper, Duménil gave full credit to Graves for having first suggested peripheral neuritis as the cause of the paralysis. Analyzing his own cases he noted that the inflammation may start as sciatica (case 1) and then spread to other nerves. Along the course of a single nerve it spreads downward, and when the inflammatory stage is passed pain disappears although atrophy may remain. He thought that the spinal cord may be involved very late in the disease, as shown by sphincteric weakness and that no changes in the brain take place. The term, ascending chronic neuritis, covers many of the cases, although in many the process does not definitely ascend or become chronic. The physiologic evidence, derived from experiments with curare and veratrine, was noted, as well as the observation by Weir Mitchell on "Gunshot Wounds and Other Injuries of Nerves" (1864). In short, Duménil gave a masterly summary of all that was known at the time about neuritis, and concluded his brilliant paper as follows:

There exists a class of spontaneous peripheral paralyses due to an atrophy of the nerves. In a certain number of cases, if not in all, the morbid process which causes these atrophies is of an inflammatory nature. These paralyses can affect feeling and motion with equal intensity, either simultaneously or successively, and



in the latter case motion appears to be affected by reflex action. They are often limited to one portion of the branches of one or several nerves, and do not necessarily correspond to the anatomic distribution of the trunks. They can be accompanied by changes in nutrition, not only of the muscles but in the skin and joints, as in the case of paralysis resulting from traumatism of the nerves. The morbid process which produces them may follow an ascending course and extend to the spinal marrow, where it leaves unquestionable material traces. Pathologic anatomy thus gives full proof of Graves' opinions. The symptoms of these paralyzes reproduce those of paralyzes through traumatism of the nerves almost identically, but their progress deserves a special study. They are capable of being cured, but often the cure is slow and remains incomplete. The return of sensation and motion ordinarily follows the same progression. They can cause death by becoming general and by the extension of the changes to the elements of the spinal cord.

But novel views, such as those of Duménil, are accepted grudgingly. Cases continued to be reported, which are clearly neuritis of the Graves-Duménil type, as myelitis or spinal meningitis. Sigismond Jaccoud,<sup>22</sup> for instance, in his medical clinics at the Charité, although he was entirely familiar with the work of Graves, Duchenne, Landry and Duménil, could not bring himself to a point of accepting peripheral neuritis as an entity, and preferred to use the term progressive nervous atrophy.

E.-F.-A. Vulpian,<sup>23</sup> moreover, over ten years later, still clung to the theory that meningomyelitis was the cause of a typical case of multiple neuritis, although he was familiar with the reports of Landry on acute ascending paralysis. Duménil had long been forgotten; he was not even mentioned in 1879 by Vulpian, one of the leaders of French neurology.

Advance in regard to the knowledge of neuritis, however, was not at a standstill, for Lancereaux,<sup>24</sup> who had long been interested in lead neuritis and who had reported a case with observations on the pathologic process as early as 1862, continued to show an interest in this form of the disease, and published a more detailed report in 1871.<sup>25</sup> Lancereaux's early case is of interest only because of the detailed changes of the pathologic examination.

The patient, a man, aged 37, was severely poisoned, and showed signs of albuminuria, epilepsy, blindness, colic, aphonia and paralysis. Changes were found postmortem in the brain, spinal cord, nerves and muscles, as might be expected in such a well marked case.

22. Jaccoud, S.: *Leçons de clinique médicale*, Paris, A. Delahaye, 1867, p. 416.

23. Vulpian, E.-F.-A.: *Maladies du système nerveux: maladies de la moelle*, Paris, O. Doin, 1879, p. 195.

24. Lancereaux, E.: Note relative à un cas de paralysie saturnine avec altération des cordons nerveux et des muscles paralysés, *Gaz. méd. de Paris* **17**:709 (Nov. 15) 1862.

25. Lancereaux, E., and Lackerbauer: (a) *Atlas d'anatomie pathologique*, Paris, G. Masson, 1871, vol. 2, p. 484; (b) *Gaz. méd. de Paris* **26**:385 (Sept. 2) 1871.

At the time of publication the question of the dependence of the changes in the muscles on the peripheral nerves or on the lesions in the spinal cord was still debatable, and Lancereaux was unable to reach a final decision on the basis of his observations, two years before Duménil's enlightening paper. He pointed out, however, that the lesions in the muscles were not, in themselves, the result of the disease, but that it seemed probable that the paralysis was the result of disease of the nerves or spinal cord.

In 1871 Lancereaux<sup>25</sup> returned to the same subject, reporting a new case, somewhat complicated by gout and interstitial nephritis. The changes in the muscles noted post mortem were beautifully illustrated by the drawings of Lackerbauer.<sup>26</sup> The pictures, in color, show the atrophy and pallor of the extensor muscles of the wrist, sparing the supinator longus and longitudinal and cross-sections of the muscles. The spinal cord in Lancereaux's patient, a painter, aged 43, observed in the Charité, in 1870, was said to be normal when examined by Pierret. The radial nerves showed marked degeneration. Lancereaux reiterated his belief that the atrophy of the muscles is not simply due to the disease, apparently a still contested point.

Two years later Gombault<sup>27</sup> had occasion to observe and study pathologically another case of lead paralysis, and was able to supplement Lancereaux's findings by a more detailed study of the lesions in the nerves. The patient, a man, aged 48, was in Charcot's service at the Salpêtrière, in 1872. There was well-marked paralysis of the extensor muscles of the wrist without sensory changes. Post mortem no changes were observed in the central nervous system, but the peripheral nerves were extensively involved by interstitial neuritis.

Gombault's paper was not illustrated, and it fell to Westphal<sup>28</sup> in Berlin, to draw the first pictures of degeneration of peripheral nerves, the result of lead neuritis. The clinical case was reported by Bernhardt,<sup>29</sup> who was familiar with the work of Lancereaux and Gombault.

The patient, a painter, aged 47, was first seen in 1872. There was a previous history of colic. Wrist-drop, with reaction of degeneration, except for the supinator longus, was noted. Death occurred within a month of heart disease.

All the principal work on neuritis and lead paralysis up to this time had been done in France, except the contributions of Lettsom and

26. Lancereaux and Lackerbauer,<sup>25a</sup> vol. 2, plate 53.

27. Gombault, M.: Contribution à l'histoire anatomique de l'atrophie musculaire saturnine, *Arch. de physiol.* 5:592, 1873.

28. Westphal, C.: Ueber eine Veränderung des Nervus radialis bei Bleilähmung, *Arch. f. Psychiat.* 4:776, 1874.

29. Bernhardt, M.: Zur Pathologie der Radialisparalysen, *Arch. f. Psychiat.* 4:601, 1874.

Graves in England and of Jackson in America. The year 1874, therefore, marks a turning point from France to Germany, strikingly illustrated by Westphal's report, the first German contribution to the subject. His colored plate<sup>30</sup> shows clearly the degeneration of the axis-cylinders of the radial nerve.

To return to the more general forms of neuritis, Eichhorst's<sup>31</sup> case of the acute form with fever was the first of its kind to be reported in detail.

His patient, a woman, aged 66, entered the Charité in July 1875. Sudden paralysis of the feet, with marked pain followed by anesthesia and electric changes, later passing to the arms, led to death in about three weeks. There was an irregular fever with a variation in temperature of from 36 to 40 C. (96.8 to 104 F.) (table 9). The peripheral nerves were degenerated, and are well shown in the figures (table 8).

Finally, Joffroy<sup>32</sup> separated the localized from the generalized forms of parenchymatous neuritis, and the whole history of the subject as well as a review of the literature was published in the Paris thesis of Gros.<sup>33</sup>

From 1880 the literature grew in great volume; a partial list up to 1900, on symmetrical polyneuritis alone, covers seven pages of Remak and Flatau's<sup>34</sup> exhaustive treatise. Ernst von Leyden, whose great position in Berlin gave a final stamp, as it were, to the peripheral nerves as opposed to the spinal cord as the site of the disease, published two reports in 1880; the first and most important in his new journal, the *Zeitschrift für klinische Medizin*.<sup>35</sup> The literature was thoroughly reviewed, and 2 cases were reported, both with postmortem examination. A similar article, giving only the report of the first case, was published by von Leyden<sup>36</sup> in the same year. In 1881 Grainger Stewart,<sup>37</sup> of Edinburgh, reported 3 more cases, 1 with postmortem study. This was

30. Westphal,<sup>28</sup> plate X, p. 776.

31. Eichhorst, Hermann: Neuritis acuta progressiva, Virchows Arch. f. path. Anat. **67**:265, 1877.

32. Joffroy, Alix: De la névrite parenchymateuse spontanée, généralisée ou partielle, Arch. de physiol. **6**:172, 1879.

33. Gros, J.: Contribution à l'histoire des névrites, Thèse de Paris, J. B. Ballière, 1879.

34. Remak, Ernst, and Flatau, Edward: Neuritis und Polyneuritis, in Nothnagel, C. W. H.: Spezielle Pathologie und Therapie, Vienna, A. Hölder, 1900, vol. 11, p. 422.

35. von Leyden, E.: Ueber Poliomyelitis und Neuritis, Ztschr. f. klin. Med. **1**:387, 1880.

36. von Leyden, E.: Ueber einen Fall von multipler Neuritis, Charité-Ann. **5**:206, 1880.

37. Stewart, Thomas Grainger: On Paralysis of Hands and Feet from Disease of Nerves, Edinburgh M. J. **26**:865, 1881.

the first paper in English which adequately covered the subject; it served to bring the concept of neuritis before the English-speaking world.

Thus has been the growth of knowledge of peripheral neuritis through a period of more than one hundred years. The striking clinical descriptions of Lettsom and Jackson of the alcoholic form, the equally brilliant work of Chomel, the suggestion of Graves in regard to the peripheral nerves, so quickly forgotten, the preliminary but faulty work of Landry, the conscientious work of Duménil, who made Graves' suggestion a certainty, to the finality of the reports by von Leyden and Stewart form a bizarre record of halting progress. In spite of many detours and failures to read the signs erected by previous wayfarers on the road, advance was made. Such is the record and by such uncertain steps do the science and art of medicine ever move forward.

## Clinical Notes

### SPINAL ANESTHESIA INEFFECTIVE FOR OPERATION ON TUMOR OF THE CAUDA EQUINA

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This communication presents an instance of the failure of spinal anesthesia in an operation on a tumor of the cauda equina. The observations are of importance because they support the supposition, which is only fairly well established, that the drug used in spinal anesthesia produces its effect by a blockade of impulses in the spinal root filaments rather than by a direct action on sensory fibers in the cord itself.

#### REPORT OF CASE <sup>1</sup>

*Clinical History.*—Ulric L., a French shoemaker, aged 40, father of six children, was admitted to the surgical service of the Peter Bent Brigham Hospital on Oct. 4, 1922, because of incontinence of urine and feces and pain and weakness in the legs. His heart had suffered damage during four attacks of inflammatory rheumatism, but he had been working until ten weeks before admission. The present illness had begun approximately four years before, with the onset of constipation and the occurrence of bloody stools. For three years there had been absence of sensation in the perineum, rectum and genitalia, with loss of sexual appetite, and the patient had had no erections for ten months. Urinary frequency of three years' duration had developed into incontinence six months before entry, and there had been symptoms of cystitis for ten weeks.

*Examination.*—The patient was very pale and emaciated, and had a distended bladder, a lax rectal sphincter and anesthesia of the rectum and perineum. The right achilles reflex was absent, but other reflexes were normal.

The patient's general condition was very poor; he had an irregular elevation of temperature to nearly 101 F.; the hemoglobin was 30 per cent; the red blood cells numbered 2,500,000; excretion of phenolsulphonphthalein was 10 per cent in two hours.

Roentgenograms demonstrated evident involvement by pressure of the fifth lumbar lamina, as well as of the entire sacral canal, which gave an appearance suggesting a chondrosarcoma.

Lumbar punctures in the fourth and fifth lumbar spaces were unsuccessful, but in the second space a puncture yielded light canary-colored fluid with increased protein.

*Course.*—After a month of hospital care, during which constant urinary drainage was maintained, the general condition improved markedly and an operation was undertaken.

*Operation* (Dec. 5, 1922, by Dr. Harvey Cushing).—Lumbar puncture at the second interspace was repeated, and 10 cc. of pale, xanthochromic fluid was

1. This case was reported previously by Cushing and Ayer (Xanthochromia and Increased Protein in the Spinal Fluid Above Tumors of the Cauda Equina, Arch. Neurol. & Psychiat. 10:167 [Aug.] 1923).



removed, flowing freely. Two cubic centimeters of 5 per cent procaine hydrochloride (100 mg.) was introduced. In less than twenty minutes a girdle of anesthesia was noted above the operative site, but sensation below, in the region to be operated on, remained undisturbed; so in order to perform the operation it was necessary to administer ether. The operation consisted in partial removal from the sacral region of a huge tumor, which appeared to have destroyed the dura. The tumor proved to be glioma.

The patient made an excellent operative recovery, and regained some urinary function and some degree of sexual sensation. Soon after return home he suffered from an attack of cardiac decompensation, from which he made a satisfactory recovery, but chronic urinary infection and anemia recurred. He died at home on Nov. 17, 1924, a little less than two years after operation. Autopsy was not performed.

#### SUMMARY

A case is reported in which spinal anesthesia for operation on a large tumor of the cauda equina was induced by injection of 100 mg. of procaine hydrochloride into the lumbar cerebrospinal spaces, just above the lesion. A girdle of anesthesia above the level of the tumor resulted, yet the operative field retained complete sensation, so that it was necessary to administer ether to perform the operation. This indicates that while the anesthetic drug bathed the lumbar portion of the cord and blocked impulses of certain susceptible fibers which supplied the girdle already mentioned, it failed to penetrate the cord itself in sufficient amounts to block ascending impulses from the sacral regions and the cauda equina. These facts support the supposition that spinal anesthesia does not block impulses by acting on the sensory fibers of the spinal cord itself, but rather by acting on smaller and more susceptible nearby structures, possibly on the spinal root filaments.

## ELABORATE MENTAL STATES AFTER SLIGHT EPILEPTIC PAROXYSMS

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In accordance with his views on duplex symptomatology, Hughlings Jackson maintained that one may distinguish in the state of a patient after an epileptic fit two elements: (1) a negative element, due to the exhaustion of the highest centers, and (2) a positive element, represented by the activity of intact lower centers, this activity being permitted by the suspension of the control normally exercised by the highest centers. In Jackson's words, "there is (1) loss of control *permitting* (2) increased automatic action" [I, 123].<sup>1</sup>

There is a relationship between the severity of the fit and the degree of subsequent disability and the complexity of such automatic behavior as may occur. The severest fit is followed by a complete suspension of activity save for the persistence of circulation and respiration. Here the dissolution is deep and the disability great, while the actions permitted are the least complex. On the other hand, the slightest fit, since it leads to exhaustion of only the highest layer of the highest centers, may be followed by elaborate activity. Here the dissolution is shallow and the disability slight, while the automatic actions permitted are correspondingly complex.

In support of these views Jackson observed that the most elaborate mental states occur after the slightest fits. He called attention to two points [I, 127]: The slightest the fit (1) "the more highly compounded (are) the actions permitted," and (2) "the more are they developed by external circumstances occurring just before, during, or after the paroxysm." As an illustration, he cited [I, 126] the case of a man who reported that after a slight fit he was found "standing by the table mixing cocoa in a dirty gallipot, half filled with bread and milk intended for the cat, and stirring the mixture with a mustard spoon *which I must have gone to the cupboard to obtain*" (the italics are Jackson's). This is an instructive example of a slight fit being followed by automatic actions which are highly compounded and to a remarkable degree adapted to the circumstances of the moment. Instances of still more complex activity occurred in the case of Z [I, 399 and 458]. The patient had a slight fit while crossing a Swiss glacier [I, 403]. He was jumping across many small crevasses when the fit began, and when the fit was over "I looked back with surprise at the long slope of broken ice I had run over unhurt, picking my way, I know not how, over ground that would normally have been difficult to me." The same patient once had a slight fit while playing lawn tennis. On this occasion the fit "did not in the opinion of my adversary make my strokes or judgment of pace and position of balls to be struck any worse than normal. I had no recollection of the strokes during a minute or two."

Since the most elaborate actions are those of speech, it is interesting to consider to what extent patients speak (or write) during postepileptic elaborate mental states. Jackson gave several cases, which I list in the order of complexity.

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1. Bracketed figures refer to the volume and page of Selected Writings of John Hughlings Jackson, edited by James Taylor, London, Hodder & Stoughton, 1931.

## SPEECH FOLLOWING SEIZURES

*Speech of Least Complexity.*—A patient [I, 130] after a fit said, "Wait a bit, Bill. I am coming." Bill, a friend, was not present at the time of the utterance. Here one sees inferior speech, inferior in that it was not adapted (or very poorly adapted) to the circumstances of the moment.

*Speech of Medium Complexity.*—The patient, M. W. [I, 399], "may reply, but gives random answers." Here is a small degree of adaptation since the utterance is a reply. Similarly, the patient Z, previously mentioned, sometimes replied to questions, though not always pertinently, by saying "Yes" [I, 402].

*Speech of Greatest Complexity.*—Z, who was a physician, had a slight fit while examining a patient. He told Jackson [I, 404]: "Whilst he (Z's patient) was undressing I felt the onset of a petit-mal. I remember taking out my stethoscope and turning away a little to avoid conversation. The next thing I recollect is that I was sitting at a writing-table in the same room, speaking to another person, and as my consciousness became more complete, recollected my patient, but saw he was not in the room. I was interested to ascertain what had happened, and had an opportunity an hour later of seeing him in bed, with the note of a diagnosis I had made of 'pneumonia of the left base.' I gathered indirectly from conversation that I had made a physical examination, written these words, and advised him to take to bed at once. I re-examined him with some curiosity and found that my conscious diagnosis was the same as my unconscious—or perhaps I should say, unremembered diagnosis had been." Z's activity in this instance represents mentation of a remarkably high degree of complexity. Jackson [I, 460] gave several examples of written memoranda made by Z after slight fits which came on while he was in the act of examining a patient. Another of Jackson's patients, Quaerens, also a physician [I, 388], had fits which were so slight that "strangers noticed nothing wrong with him; he is never quite unconscious in them; the severest of these slight fits only 'bemaze' him for a minute or two; he can go on talking."

In the following case, which I studied after I became familiar with Jackson's views, the patient showed interesting elaborate mental states after slight seizures. His mother is above the average in intelligence, and gave precise data regarding many of the seizures which she observed.

## REPORT OF A CASE

The patient was an intelligent machinist's helper, aged 24 when I saw him.

*Major Seizures.*—From 2 to 4 years of age he had occasional convulsions. These ceased entirely.

*Minor Seizures.*—At the age of 18 he began to suffer from minor seizures followed by abnormal mental states which the mother easily recognized because he had a "starey look" and made inferior utterances in an angry tone (normally he was of a gentle disposition). The postparoxysmal mental states lasted, at most, for a minute or two. He never fell, but often dropped things. Thus when a seizure occurred during a game of cards he usually dropped the cards. On one occasion he wet himself; he never soiled himself. Seizures occurred, on an average, twice a week.

The following examples illustrate the postparoxysmal utterances. They are grouped according to whether the utterance occurred spontaneously or in response to remarks addressed to him.

*Utterances Made Spontaneously.*—1. Most frequently, if the patient said anything, it was the word "what" repeated as often as seven or eight times. The following examples are some exceptions. 2. The patient was once sitting at a window looking out when a seizure occurred. A Chevrolet automobile (commonly called "Chevvie") was standing at the curb. During the attack the mother heard him say several times, "It's a Chevvie." 3. A seizure occurred while he was in the bathroom looking at himself in the mirror. The mother heard him say, "Well, why don't you say something? Say something!" He was apparently talking to his image in the mirror. Later the mother learned that he had felt it coming on and had gone to the mirror to see what he looked like during an attack. 4. The patient was talking to his mother and to an acquaintance named George. During the attack he looked at George and asked several times, "What's *your* name?" 5. While reading a detective story magazine he had a seizure, after which his mother heard him say several times, "*This* book." 6. A seizure occurred at the table. The meat was on the table, but had not yet been served. During the attack he said several times, "*That* meat." 7. The patient and some relatives were crossing a bridge on foot. He was carrying his niece, aged 2, on his right arm. Suddenly a seizure occurred, after which he said several times, "Where are we going?" His right arm began to slip, and the others quickly took the child from him. 8. The patient was playing checkers with a friend named Harry. Harry was slow in making a move. A seizure occurred, after which the patient said, "Well! aren't you going to move? If you don't move, I'll move your head for you!"

*Utterances Made in Reply to Questions.*—9. Once the patient was drying a tray when a seizure occurred. (The patient is right-handed, and the towel was in his right hand.) The tray fell from his hand, but not the towel. When the tray fell, his mother asked him, "What in the world are you doing?" He replied, "I just let it fall," repeating this several times. 10. The patient and his mother were helping to paint a room. The landlord's son Harry was there. While the patient was painting the door, a seizure occurred. The mother, noticing the characteristic "starey look," said to Harry, "He is having a spell." Harry then called to the patient, "Ted, put the brush in the can." Ted replied, "Can? Can? Where is the can?" 11. The patient was visiting his aunt. The aunt was in the kitchen while her daughter, aged 8, was in the front room, where the patient was putting on his coat, preparing to go home. A seizure occurred, after which the patient said to his little cousin, in the characteristic angry tone, "Are you going along?" The aunt, hearing the tone, knew that he was having an attack, came into the room and asked, "Going along *where*, Ted?" He replied, "Home, home."

*Memory for the Attacks.*—The patient gave me the following description of his attacks: "It starts here (epigastrium)—it's an odd sort of feeling—then it goes up here (neck), then my mouth waters, then I say things." The mother, however, assured me that with one exception he never remembered, after the attack, what utterances he had made. The one exception was the episode in which he said, "It's a Chevvie" (already cited).

Neurologic examination revealed nothing significant.

#### COMMENT

In some of the examples given the patient's utterances were remarkably well adapted to the circumstances of the moment. For example, in episode 9 the utterance "I just let it fall" is a complete and relevant answer to the question

which his mother asked him. In episode 11 the utterance "Home, home" is a correct answer to the question. In episode 8, which occurred during the game of checkers, the utterance was relevant to the situation, though of course the fact of its vocalization represents inferior behavior. A healthy person in the same situation might be irked by his opponent's slowness, but would not utter the angry remark made by the patient.

In episodes 2, 3, 4, 5, 6, 7 and 10 the utterances show some adaptation to the situation, but the degree of adaptation is not as high as in the episodes cited in the preceding paragraph.

This case is in keeping with Jackson's view that slight epileptic seizures, being characterized by relatively shallow dissolution, are therefore relatively apt to be followed by elaborate automatic mental states.

## Abstracts from Current Literature

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RETROBULBAR NEURITIS AND DISEASE OF THE NASAL ACCESSORY SINUSES.  
WILLIAM L. BENEDICT, Arch. Ophth. 9:893 (June) 1933.

In a consideration of retrobulbar neuritis and disease of the nasal accessory sinuses, knowledge of the position of various bundles of fibers in the nerve with reference to the retinal elements and their projection into the visual field is used as a basis for determining the situation of obstructions along the visual pathways. Homonymous anopsias and scotomas are of particular significance. In addition to defects of the field, the ophthalmoscopic examination of the fundus is important. Central visual acuity is an important item in the data for understanding the nature of lesions of the optic pathways.

Disturbance of vision constitutes the chief symptom of conditions which affect the optic nerves, tracts and radiations, and the cause of such disturbance may lie entirely outside the nerve. Anatomic anomalies, such as abnormally placed bony structures, abnormal blood vessels, cranial disturbances and deformities and tumors with direct or indirect pressure, may be the cause of a partial or complete atrophy.

Interruption of function of a portion of the optic nerve produces various changes. It is important to understand that the optic nerve will recover from the effects of injury sufficient to cause temporary total blindness. This phenomenon constitutes the basis for all forms of treatment for optic neuritis, and is of primary significance in a consideration of treatment for retrobulbar neuritis. The effect on vision by other circumstances, such as toxins, degenerative lesions and diseases of the nerve itself, endogenous toxins associated with acute and chronic diseases and particularly diseases of the paranasal sinuses, is a second, but as important, etiologic factor.

In studying such a case, the author desires that special care be paid to obtaining a careful history of the onset and course of the visual disturbances. The loss of vision may extend slowly for several days. Simultaneous occurrence of symptoms in both eyes is rare, although one eye may be severely affected, whereas the visual acuity of the other may be only slightly diminished.

In considering the course of the visual disturbance, recovery in acute cases may be unusually rapid. In many cases central vision may remain stationary for days or even weeks. In others the loss of vision may be so gradual that when first noticed the defect, even in the peripheral field, may be well advanced. Permanent blindness may be reached only after weeks or months of slowly progressive expansion of a central scotoma. Recurrence may occur, of greater or lesser severity, at intervals of as long as ten years. Two cases were reported of recurrence after twenty-four years and after forty-seven years, respectively. Complete recovery may follow recurrence in such instances. Spontaneous recovery of vision has been seen in retrobulbar neuritis caused by multiple sclerosis and alcohol and nicotine poisoning, and in other cases of undetermined origin.

Much has been written on the anatomic position of the fibers of the optic nerve and their relation to the nasal accessory sinuses, from which one gains the impression that disease of the sinuses or changes in their structural development have a direct bearing on the function of the optic nerves through contiguity. The anatomic variations in the sinuses permit a variety of relationships between the sphenoid and ethmoid cells and the nerve, in its passage through the optic foramen and on to the chiasm. It has been intimated that disease of the mucosa of the accessory sinuses may be transmitted to the optic nerve through direct extension or by diffusion of toxic material along the blood vessels that traverse the region. The incidence of retrobulbar neuritis from a pathologic process in the nasal accessory sinuses is slightly higher in the United States than in Europe. On the other hand, it seems that multiple sclerosis is more frequent in Europe than in the



United States. Another most important and relevant factor is the very high frequency of a pathologic process in the nasal accessory sinuses and the relative infrequency of retrobulbar neuritis. Most writers agree that multiple sclerosis accounts for the greatest number of cases.

De Grósz observes annually approximately 100 cases of retrobulbar neuritis, in 15 per cent of which the cause is nasal. Gifford found 3.5 per cent of cases with nasal etiologic findings in retrobulbar neuritis. Wiener, in 1931, stated: "I could report case after case where no suppuration was found in the nose, in which optic neuritis or retrobulbar neuritis subsided with shrinking of the mucous membrane of the nose. The visual acuity improves, the scotoma gets smaller or disappears, and the symptoms of the blur are dissipated." The author states: "When one considers the vast number of cases of severe suppurative sinus disease without visual symptoms, the connection between sinus disease and retrobulbar neuritis becomes much less credible. Even in the presence of dehiscences in the bony walls in either acute or chronic disease of the ethmoid and sphenoid cells lying near the optic nerve, the incidence of visual disturbances in patients seen in the Mayo Clinic is negligible. The transmission of inflammation from the sinuses to the optic nerve, either by direct extension, through the blood or lymph stream, or by toxins emanating from slightly thickened mucous membranes and diffused as noxious vapors, has received no convincing experimental corroboration."

He gives in support of his opinion an analysis of the etiology of 225 cases of retrobulbar neuritis at the Mayo Clinic in the following statistics: multiple sclerosis in 155 cases, pernicious anemia and nicotine in 14, diabetes in 14, alcohol and tobacco in 28, syphilis in 2, congenital amblyopia in 4, familial causes in 1, sinus disease in 1, postpartum hemorrhage in 1, plumbism in 2 and indeterminate causes in 3. In support of this he draws another conclusion relative to surgical intervention in the nasal accessory sinuses and the effect of this intervention. He believes that the secondary traumatic results are of importance: "Operations on the nasal sinuses have two effects which have not been fully taken into account by those who advocate them for retrobulbar neuritis. Packing of the nose with cocaine and epinephrine for anesthesia produces, first, ischemia and then congestion of the membranes. Following the operation there is continued congestion of the mucosa of the sinuses and the adjacent tissues until healing is complete. If the operation has been sufficiently extensive, there is commonly a rise of temperature of 1 or 2 degrees F. from the absorption of blood, which, in effect, is autovaccination. These two factors are similar to the effects produced by injections of foreign proteins, and the results are parallel. It is my conviction that drainage of secretion from the paranasal sinuses is not the prime factor in the relief obtained by the operation, but that the hyperemia due to the packing and reaction of the operation and the inoculation by absorption of blood are the factors which are responsible for any improvement noted. This conviction is further supported by the course of many patients following operation. Operations on the sinuses are followed by quick improvement, but too often relapses occur shortly after operation because hyperemia has not continued long enough. . . . If a suppurative disease of the sinuses is obviously present, an operation should be performed for relief of the local condition, and additional measures employed to treat the retrobulbar neuritis, for even in the presence of infection of the sinuses, one cannot be sure that some other factor is not present. Operations on the sinuses, in most instances, probably do little harm. In many cases they do some good. The chief objection lies in the employment of an inadequate and unwarranted procedure, when better methods of treatment are available."

SPAETH, Philadelphia.

RECENT APPLICATIONS OF THE "STUDY OF VALUES." H. CANTRIL and G. W. ALLPORT, *J. Abnorm. & Social Psychol.* **28**:259 (Oct.-Dec.) 1933.

Cantril and Allport have devised and standardized and have previously published data on a test for the purpose of measuring simultaneously the relative prominence of six basic interests in personality (the theoretical, the economic, the

esthetic, the political, the social and the religious). The subject's score with this test merely shows the relative preference for, or attitude towards, one of the interests as compared with the others and, therefore, is not directly comparable with the score of another person for the same value. It shows merely the relative interest in the hierarchy of these various interests as outlined.

In the original standardization group of 776 persons, the mean score for each of the values was almost 30. To this group has been added another series of 1,979 persons, from a variety of industrial and professional groups and from many types of schools and colleges. After the additional scores were added and the data compiled, the mean score for the entire group was still 30. There were some significant sex differences. The esthetic, social and religious values play a relatively more important rôle in the personalities of women than of men, and, conversely, men are relatively stronger in theoretical, economic and political interests. As stated in the original description of the test, scores for the social value are the least reliable and their interpretation therefore is doubtful, whereas the measures of the esthetic and religious values are the most reliable.

Enough data are now available to show that the "study of values" is markedly successful in differentiating groups of subjects who have varying occupational interests. Commercial students were found to have the greatest interest in economics, and missionaries of both sexes, in religious matters; students of salesmanship (male) showed the greatest interest in economic affairs; female students of literature showed the greatest interest in the esthetic topics; female students of science showed interest centered largely in the theoretic aspects, and male trustees among prison inmates tested showed interest of the greatest magnitude in economic subjects. The study of values also shed interesting light on the rather obscure problem of "college types." According to the test, Radcliffe College leads in the relative prominence of theoretical interests, Wellesley College in religious interests, Stanford University and Wheaton College in esthetic interests, Barnes Commercial College in economic interests, Wheaton College in social interests and Boston University (Practical Arts) in political interests.

G. E. Stromwall analyzed the relationship of the reaction of the individual subject both to the Rorschach ink-blot test and to the study of values and found some interesting comparisons. Subjects who see the ink-blot as objects in motion are most creative and most introversive. Subjects found to have high religious and esthetic interests actually give more of these motion responses and therefore show a higher degree of creativity and introversiveness. Subjects with high political interests tend on the whole to have greater extrovertiveness in emotional responses. Subjects with high esthetic scores give a greater proportion of detail in the ink-blot test, which means that they view the blot less as a whole and more with an eye as to its subdivisions.

A. G. Woolbert prepared an artificial newspaper composed of twenty-two news items clipped from the *New York Times* which illustrated six topics of interest, representing Spranger's six types of value. Subjects were given a limited time to read this paper and were asked to check the headlines which had interested them and to indicate the items which had been passed over. The direction of the results demonstrated clearly the operation of a reader's personal values on such a casual activity as the perusal of the daily news, for the correlation between the form of test on the study of values and the choice of newspaper items was 71 per cent.

J. M. MacDonald prepared a questionnaire listing ten attributes which an ideal person might have in order to find if the dominant interest which a person has affects his conception of the qualities which an ideal person should possess. The conclusions were that a religious person believes not only that a religious interest is essential in an ideal person but that a theoretical interest is unimportant. The esthete believes that an esthetic interest is necessary and also that a theoretic interest is important, but that a religious interest is unnecessary. For an economic person an economic interest is important, while an esthetic interest is unimportant. To a certain degree the person with political trends holds that an interest in power is necessary and that an interest in beauty is irrelevant. The theoretical person

does not believe that an ideal person should necessarily possess a theoretical interest. In a way similar to this, H. G. Nickerson, in a test to determine what qualities were necessary in a leader, found the same tendency toward projection, each type believing that his own type was necessary to a leader, with the exception of the theoretical person, who did not believe that his own qualifications were necessary for leadership or for perfection.

These experiments demonstrate a clear relationship between values and conduct. They show that a person's activity is not determined exclusively by the stimulus of the moment, by mere transient interest or by a specific attitude peculiar to each situation which he encounters, but that general evaluative attitudes enter into various common activities of everyday life and in so doing help to account for the consistencies of personality.

WISE, Howard, R. I.

COLOUR VISION REQUIREMENTS IN THE ROYAL NAVY MEDICAL RESEARCH COUNCIL, Special Report Series, no. 185, London, His Majesty's Stationery Office, 1933.

Three reports on the problems of color vision have been published so far by the Medical Research Council in this series: (1) "Re-Determination of the Trichromatic Mixture Data," (2) "Individual Differences in Normal Colour Vision" and (3) "Determination of the Sensitiveness of the Eye to Differences in Saturation of Colours." A review of the last two will appear shortly. These reports deal mainly with the theoretical and bibliographic aspects of the subject. The present report, on the other hand, is essentially a practical study. The work was undertaken at the request of the British Admiralty and was done with the aid of facilities given by the Royal Navy. On the completion of the report, it seemed to the committee that the results had a wide public interest, transcending the conditions and requirements of the particular service, and they were therefore published with the permission of the Lords Commissioners of the Admiralty.

A few figures taken from the official records available are sufficient to demonstrate that the system being used for testing color vision are unsatisfactory. Between January, 1929, and October, 1931, 93 seamen were discharged because of dangerously defective color vision. The application during the same period of a normal standard to ratings of all branches of the service would have necessitated the discharge of more than 340 men because of disabilities. In a consecutive series of 1,100 recruits, all of whom had been accepted by recruiting officers or by civil medical practitioners, 19 were rejected at a final medical examination on account of defective color vision. Of a consecutive group of 568 seamen, 20 should not have been permitted to enter the navy. A mixed group of 105 men drawn from various departments contained 5 with crudely defective color vision.

The principal contributory causes for the present unsatisfactory position of color vision tests are: (1) insufficient knowledge on the part of examining medical officers concerning the complex facts of color vision, with consequent inability to appreciate the necessity for precision in the technic of testing and in the interpretation of the results obtained; (2) the absence of explicit official instructions regarding the detection of color blindness; (3) the inadequacy of the time and apparatus available for the testing of candidates; (4) the application of an undefined "normal" standard of color vision to all branches of the service, regardless of the relation between color vision and the respective duties.

Color vision and its relationship to look-out duties at sea are discussed. Some important facts concerning color vision are mentioned; many of them being given in detail as they apply to navigation. Some fallacies persistently advanced by people with insufficient knowledge of the subject are mentioned with detailed examples.

Apparently an effective system of tests should meet the following requirements: (a) The tests should enable an expert examiner to reject all dangerous candidates and to accept all safe candidates. (b) The apparatus should be free from all avoidable mechanical complications. (c) The tests should be adapted for rapid

application to allow considerable numbers of candidates to be tested in a reasonable period of time. (d) One of the series should be a color-naming test. The colors as seen under all working conditions on the open sea should be reproduced with the greatest fidelity attainable. (e) The combination of tests should be efficient for eliminating malingering. Unfortunately, no combination of technical tests hitherto devised fulfils completely all these requirements.

The basis of the tests used included the three different types: lantern tests, pseudo-isochromatic tests and spectroscopic tests. No single test is infallible. Thus, any normal trichromat can pass Ishihara's test with ease, but unfortunately a certain number of candidates—particularly those with shortening of the red end of the spectrum—who pass this test fail to pass the lantern test. Hence, Ishihara's test, if it is the only test employed, does not insure the same performance of lookout duties. Conversely, a considerably greater number of candidates who make mistakes in Ishihara's test can pass any reasonable lantern test. Therefore, Ishihara's test, if used alone, causes the rejection of candidates who may be fit even for the Seaman Branch.

The committee recommends the withdrawal of all other tests formerly used, especially Holmgren's test. The bead test can be useful for the detection of central color scotoma and as a rough preliminary test, but the selection of the beads should not be left to local purchase. The examiners paid special attention to the pseudo-isochromatic tests as shown by the special cards, the Edridge-Green lantern test and the Board of Trade lantern test. Spectroscopic tests, which comprise scientific tests of the highest precision, are not thought necessary for routine performance. For certain difficult cases the committee recommends more precise scientific tests than any described in this report. There are many other recommendations in the report which are of great interest. The entire article should be of considerable value in establishing more uniform examinations for this function, as color perception is of importance in navigation as well as having many other important applications in the various systems of transportation.

SPAETH, Philadelphia.

STRUCTURAL CHANGE IN THE GRANULAR LAYER OF THE CEREBELLUM. E. Y. WILLIAMS, Arch. Path. 17:206 (Feb.) 1934.

The purpose of this study was to determine if, to the various pathologic lesions of the cerebellum already described, there could be added another condition which has been recorded as "conglutination of the granular layer," and if other pathologic changes of that layer could be found. Conglutination consists of a clumping of numerous cells of the granular layer, which lose their individuality and form irregular and solid masses of elements undergoing more or less advanced degeneration. Such pathologic changes, which have already been described by Ferraro and Morrison in various experimental conditions, have been investigated in the course of this study in animals and in various human pathologic conditions. The granular cells are karyochrome and are rather small, about 0.7 micron in diameter. The nucleus is rather large and surrounded by a cytoplasmic ring which is fairly narrow. Each cell has from three to six fairly short dendrites, which terminate close to the cell body in what may be called a limited arborization. Where these arborizations meet, there results an apparent empty space known as dendritic islands. The axons of the granular cells extend through the superficial, deep and intermediate levels of the molecular layer, from all of which positions they give rise to the typical T-shaped and at times Y-shaped branches. They are without myelin sheaths. The synaptic union between the axons of the granular cells and the dendrites of the Purkinje cells is of the cruciform variety and thus brings about extensive Purkinje synaptic connections.

In order to establish if postmortem changes could determine the occurrence of conglutination in the granular cells of the cerebellum, partial removal of the cerebellum was done immediately after the death of a cat and twenty-four and thirty-six hours following death. The purpose was to see if the time between death

and fixation would have any influence in establishing conglutination. It was found that none of the specimens showed any conglutination.

In order to study the distribution of these granular cells in normal persons, three cases of sudden accidental death were studied. Conglutination was not found.

Histologic changes in the granular layer were studied in: dementia praecox, four cases; dementia paralytica, five; cerebral syphilis, four; Huntington's chorea, three; Schilder's disease, two; various types of acute meningitis, five; electrocution, two, and epidemic encephalitis, two.

In the cases of dementia praecox there was no conglutination, except that in one case there were indications of conglutination in a few areas. In the cases of dementia paralytica the results were not constant; in some instances conglutination was absent, and in other instances it was present and even marked. Figure 8 shows definite conglutination, though some of the cells that come together have preserved their individuality. In the cases of cerebral syphilis no conglutination was present, as a rule, but rather a rarefaction of the cellular elements. In one of the two cases of epidemic encephalitis, conglutination was present, but not uniformly or in severe degree. In the two cases of Huntington's chorea loss of granular cells was found, but no conglutination. In the two cases of Schilder's disease there was no conglutination, but a definite loss of granular cells in association with a considerable amount of gliosis which was evident in the intercellular spaces, thus making the loss of cells more discernible. In the group of cases of septic meningitis there was more or less well marked conglutination. In the two cases in which death occurred from electrocution no conglutination was found, but conversely a certain amount of swelling in the individual cells, which appeared more distinct though poorly stained. The condition resembles somewhat the condition described following the injection of hypotonic solution in rabbits.

Conglutination of the granular cells is not a specific process, but occurs under a variety of pathologic conditions. It is found in acute as well as in chronic processes, but seems to be more pronounced in toxic and infectious conditions.

Besides the process of conglutination, other changes are described: 1. Rarefaction of the granular cells, a condition which may be the result of a previous conglutination. The rarefaction of the granular cells can, however, be independent of conglutination. 2. A process of acute swelling of the granular cells in which the single elements appear swollen, at times vacuolated, with a tendency to become more distinct and, apparently because of the hydropic condition, to stain poorly. This dropsical condition has been found following the injection of hypotonic solution in rabbits and in two cases in which death occurred from electrocution. 3. Rarefaction of the granular cells associated with interstitial gliosis was found in two cases of Schilder's disease.

WINKELMAN, Philadelphia.

**PATHOLOGIC ANATOMY OF THE CEREBELLUM: III. GENUINE CEREBELLAR ATROPHIES. HANS JOACHIM SCHEERER, Ztschr. f. d. ges. Neurol. u. Psychiat. 145:335 (April) 1933.**

The basis of this study is three cases, with a review of other investigations of the subject. The whole field needs clarifying.

**Cerebellar Hypoplasias:** By this is meant primary hypoplasias. The question arises immediately whether the hypoplasia is endogenous, ab ovo, or secondary to some fetal pathologic change. There are supporters of both views. Both possibilities may prevail, but the problem is always difficult in the individual case. Those who think that the process arises from fetal pathologic changes support the theory of an encephalitis, the existence of which is not proved. Scheerer reports a case of cerebellar hypoplasia in which the outstanding feature, in addition to the loss of the neocerebellum, was marked gliosis of the white matter. This he considers a primary paraplasia rather than a secondary process.

**Cortical Atrophies:** Scheerer reports two cases of complete cortical atrophy in children whose condition had been diagnosed as idiocy. No history was available in one. The other child was carried fourteen days beyond term, and in the first



few days of life had attacks of asphyxia and general atonia. When seen at the age of 2 years, she could not hold up her head, and had absence of all reflexes and a Babinski sign on the right side. Histologic studies revealed a neocerebellar atrophy. Not only were the Purkinje cells absent, but nerve fibers were also lost. The molecular layer was much reduced and had almost no small ganglion cells. These changes were ubiquitous and in one case involved the vermis as well; only the declivis cerebelli remained fairly well preserved. In the atrophied portions the Bielschowsky stain revealed an absolute loss of all fiber systems. Fibrous gliosis was present in the cortex. The dentate nucleus was intact, indicating that the cortical atrophy was not secondary. While the neocerebellum was involved chiefly, this was not absolute, the vermis being implicated also. In both cases there was severe injury of the olivary system, but the pontile system was almost completely intact. This is in sharp contrast to the olivopontocerebellar atrophies.

**Systematic Atrophies:** In these cases the Purkinje cells are more or less intact, but the molecular cells are greatly reduced. Purkinje cells of an abnormal form may be present, with a complete absence of molecules around them. The white matter shows gliosis. The picture is confusing, the cortical changes indicating a cerebellipetal type of degeneration, the white matter a cerebellifugal type. Scheerer postulates a primary involvement of the Purkinje axon in these cases, with later atrophy of the cell itself.

**Total Atrophies—Atrophie cérébelleuse tardive à prédominance corticale:** This disturbance, described by Marie, Foix and Alajouanine, involves chiefly the paleocerebellum. Rossi claimed that the flocculus is chiefly involved. Grossly, there is wide separation of the sulci on the dorsal surface, especially superiorly, anteriorly and medially, shading off posteriorly, laterally and inferiorly. Histologically there is cortical atrophy of the cerebellofugal type, with loss of Purkinje cells and retention of the fiber nets. There are also rarefaction of the granules and a decrease in bulk of the granular layer. The white matter is intact. Scheerer believes that this type of cerebellar disease is not an entity. The qualitative changes do not differ from those of other cerebellar diseases, while the localization in the paleocerebellum is similar to that of other disorders.

**Sclerosis of White Matter (Atrophia Olivopontocerebellaris):** Scheerer reports five cases. In all the vermis and flocculi escaped. The white matter was demyelinated in the involved areas but the dentate nucleus was untouched. The cerebellar cortex was normal. The glia in the white matter was increased. In more advanced cases the cortex also shows changes, characterized by a patchy loss of Purkinje cells and an increase in Bergmann glia cells. At the same time there are associated demyelination, shrinking and gliosis of the white matter. There is some involvement also of the paleocerebellum in advanced cases. The pontile nuclei, brachia pontis, olive and olivary fibers are also involved, while the dentate nucleus and brachium conjunctivum escape. All the ganglion cells in the pontile nuclei disappear and are replaced by glia, while the pyramidal fibers remain intact. The cells of the olivary bodies are also decreased and replaced by glia. The dentate nucleus and its systems are not involved in the disease process.

ALPERS, Philadelphia.

HISTOLOGIC OBSERVATIONS IN A CASE OF OLD GUNSHOT WOUND OF THE BRAIN.  
CYRIL B. COURVILLE and T. S. KIMBALL, Arch. Path. 17:10 (Jan.) 1934.

The opportunity to study the pathologic aspects of an ancient traumatic lesion of the brain is not frequently afforded, even though an abundance of neuropathologic material is available for study. It is perhaps for this reason that so little is known about the ultimate appearance and structure of this type of lesion. Aside from a revelation of the behavior of the individual elements after so long an interval, a more comprehensive conception of the life history of cerebral wounds is to be gained from a critical histologic study of such cases when they come to hand.

The case here considered is of interest from the standpoint of its twenty-two years' duration, the minimal damage to the skull and dura and the comparatively



uncomplicated character of the lesion produced by a bullet of small caliber. It was anticipated that an entirely quiescent lesion would be found histologically after this long interval. The indications of long-continued cellular activity and observations which suggested the fate of the various elements made it seem worth while to report the case.

A Mexican laborer, aged 57, died of lobar pneumonia six days after admission to the Los Angeles County General Hospital. Twenty-two years before he had been accidentally shot in the head while hunting and had remained unconscious for three weeks. Examination revealed a depression in the skull in the upper left parietal region close to the midline. There were characteristic manifestations of a lesion of the left upper motor neuron—spasticity of the extremities on the right side, atrophy from disuse, hyperactive deep reflexes in these members and pathologic responses of the toes.

This study seems to indicate that after an interval of twenty-two years, the processes of disintegration, of phagocytosis and probably also of repair were still taking place. Seriously damaged nerve cells had maintained their morphologic identity throughout this long interval. The histologic changes about the wound of entrance seem to confirm Penfield's postulates as to the mode of formation and the constituents of a cerebral cicatrix. Where there has been extensive destruction of tissue in close proximity to the pia mater and especially where the dura has been injured, a marked connective tissue and neuroglial proliferation results. An intermingling of fibers from both sources suggests some alternation and intertwining of the bundles of connective tissue and neuroglia fibers. The superficial position of the connective tissue and the deeper situation of the proliferating neuroglia answer the description of old wounds of the brain as given by Penfield and by Foerster and Penfield. The characteristic fusiform shape of the astrocytes and the arrangement of their fibers indicate their identity with the piloid astrocytes of Penfield.

From a study of the nerve cells in the isolated cortex along the dorsal margin of the hemisphere, it has been possible to learn the fate of end-bulbs formed at the ends of fibers sectioned close to their cells of origin. In Cajal's experimental injuries of the brain, fibers sectioned in the degenerative subcortical white matter or in the deeper portions of the cortex underwent change in a retrograde direction to the last collateral where a residual end-bulb was formed.

The significance of the yellowish-orange pigment contained in the macrophages scattered throughout the reticular tissue or agglutinated about the blood vessels is not entirely clear. In recent injuries the yellow color appears to be due to the presence of pigment resulting from the disintegration of red cells in the areas of local hemorrhage. While possible, it is difficult to conceive that pigment from such a source could persist for so long a time. Whether it is due to a continual process of disintegration of red cells or whether it is derived from some other source could not be ascertained.

WINKELMAN, Philadelphia.

THE ROLE OF MINERALS AND VITAMINS IN GROWTH AND RESISTANCE TO INFECTION. A. BROWN and F. F. TISDALL, *Brit. M. J.* 1:55 (Jan. 14) 1933.

There are at least ten inorganic elements which are absolutely essential for life: sodium, potassium, calcium, magnesium, phosphorus, chlorine, sulphur, iodine, iron and copper. The practicing physician is fortunate in having to watch the supply of only three of these, namely, calcium, iron and iodine. The occurrence of calcium in foods is limited. The two chief sources of supply are milk and leafy vegetables. A total of 24 ounces (680.40 Gm.) of milk per day supplies the necessary calcium intake for a child aged 10. Iron is not noticeably present in milk and cereals, the usual diet of the infant. It is present in fairly large amounts in egg yolk, liver, spinach and other green vegetables. In the center of the North American continent, the iodine content of the water is extremely low and iodized salt furnishes, for the most part, the iodine intake.

A lack of vitamin A in the diet results in a keratinization of the epithelial cells. The chief supply of vitamin A is butter-fat, egg yolk, carrots, spinach and cod

liver oil. A lack of vitamin B<sub>1</sub> results in peripheral neuritis or beri-beri, while a lack of vitamin B<sub>2</sub> results in pellagra and in, possibly, certain skin diseases. Vitamins B<sub>1</sub> and B<sub>2</sub> are found largely in yeast, wheat germ, milk, liver, egg yolk and spinach and other leafy vegetables. Vitamin C, the antiscorbutic vitamin, is found in oranges, lemons, tomatoes, cabbage and other fruits and vegetables. It is readily destroyed by heat in the presence of oxygen. Vitamin D, the antirachitic vitamin, is not found in ordinary foods, with the exception of small amounts in egg yolk and summer milk. Fish oil, such as cod liver oil, is the most concentrated natural source. In recent years vitamin D has been produced by the irradiation of ergosterol. Vitamin E, the reproductive vitamin, is found in wheat germ, lettuce and other leafy foods.

Each one of the vitamins and minerals is essential for life, so it is only reasonable to expect that if any one of them is omitted from the diet, the person will eventually lose weight and die. Experimental evidence is reported to show the effect of vitamins on growth and resistance to infection in the diet of rats. It has been stated that cereal grains furnish from 30 to 60 per cent of the calories of the average diet. Most cereal products used today are highly refined and contain a very small amount of minerals; they are almost devoid of vitamins. A cereal has been devised which contains the following: wheatmeal, 53 per cent; oatmeal, 18 per cent; corn meal, 10 per cent; wheat germ, 15 per cent; bone meal, 2 per cent; dried brewer's yeast, 1 per cent; alfalfa, 1 per cent. Children fed on this special cereal mixture gained from four to five times their expected rate, in contrast with the average rate of gain obtained while on ordinary cereals.

Tisdall concludes by saying that the exact requirements of these essentials is not known, nor is the exact amount furnished by any foods. Nevertheless, one can go a long way toward overcoming the deficiencies so frequently encountered in the average diet by building up meals around five essential articles of food: milk, to supply calcium and protein; meat, to supply protein; eggs, to supply protein, vitamins and iron; and vegetables and fruit, to supply minerals and vitamins. The remaining calories required can be furnished readily by the refined cereal and sugar products.

FERGUSON, Niagara Falls, N. Y.

PERITUBAL CANCERS AND THEIR ENDOCRANIAL PROPAGATION. M. JACOD, Rev. d'oto-neuro-ophth. 11:411 (June) 1933.

In 1921, Jacod published in the *Revue de neurologie* a discussion of this subject in which he proposed for the clinical picture the name "syndrome of the petro-sphenoidal crossroads"; it was afterward called "the syndrome of Jacod." In 1888, Silvio published a complete, detailed observation of such a case, but without comment. In the present article a discussion of the general neurologic and rhinologic ideas, gleaned from a study of clinical observations and autopsies of cases of peritubal tumors is undertaken.

The anatomy of the nasopharynx demands that malignant tumors of the nasopharynx be placed in two distinct groups: 1. The tumor starts in the vault of the nasopharynx external to the basilar fibrous bundle and grows unhindered toward the oropharynx, the nasal fossae and sinuses and the orbit. 2. It begins beneath the aponeurosis that sheathes the eustachian tube, and the development is guided by the aponeurotic formations and by the anatomic fact that the osseous eustachian tube inosculates with the cartilaginous tube. Since the growth is sub-aponeurotic, it follows the blood and lymph vessels and extends rapidly through the foramina in the base of the skull and tends to compress the trunks of the cranial nerves, becoming then endocranial. At first the symptoms are purely auricular: a tenacious subacute otitis media with tubal obstruction, a recurring exudative otitis media or an acute suppurating (or nonsuppurating) otitis media. These symptoms antedate the triad of Trotter: neuralgia of the inferior maxillary nerve, deafness and disturbed motility of the palate. Moreover, when this triad is present early, it points to an implantation outside the aponeurosis. Whenever a patient over 40 years of age presents inexplicable unilateral deep pain and a persistent otitis media without a manifest cause for its tenacity, a malignant tubal

tumor should be suspected. The pneumatic portion of the petrous tip and the anterior lacerated foramen correspond endocranially to the union of the sphenoid and petrous bones. In the immediate vicinity are the large round foramen, the foramen ovale and the cavernous groove, and this restricted area forms a veritable endocranial vasculonervous crossroads occupied by the trigeminus on one side and by the cavernous sinus on the other. The latter contains the external oculomotor nerve and, near it, the common motor oculi, the patheticus and ophthalmic nerves. Medial to it is the optic nerve. The association of truncal paralyses of the second, third, fourth, fifth and sixth nerves is indicated by unilateral neuralgia (gasserian in type) of the fifth, total or subtotal unilateral ophthalmoplegia and unilateral amaurosis. The attack on these trunks is almost simultaneous, and the group of paralyses constitutes a definite syndrome. This is particularly true of sarcomas. The epitheliomas that do not arise on the internal slope of the tubal mouth extend forward at first and later penetrate the skull at divers points outside the petrosphenoid crossroads. The criticism that the syndrome of the petrosphenoid crossroads is often exceeded (paralysis of the last four cranial nerves) may be met by the explanation that these paralyses are caused by distant adenopathies and not by the tumor itself.

DENNIS, Colorado Springs, Colo.

EFFECT ON STEREOPSIS PRODUCED BY DISPARATE RETINAL IMAGES OF DIFFERENT LUMINOSITIES. F. H. VERHOEFF, Arch. Ophth. 10:640 (Nov.) 1933.

In a recent communication published in the *American Journal of Ophthalmology* (16:589 [July] 1933) Verhoeff described a new phenomenon in stereoscopic vision. The study is continued in this paper.

In his first paper he stated: "If two nearly vertical black lines on a white background, at a slight angle to each other, are 'fused' by means of a stereoscope, they will ordinarily appear as a single intermediate line which has a fore and aft inclination. Let us assume that the upper end of the line before the right eye is tilted towards the right, and that of the other line towards the left. If now a smoked glass is placed before the right eye, the 'fused' line will swing slightly towards the left, producing also a diminution in the stereoscopic effect. If the smoked glass is placed so as to obscure only half of the line, the 'fused' line will appear bent in the middle. If instead of using a smoked glass, a graduated shadow is thrown on one line, the 'fused' line will appear slightly curved. The displacement may also be observed in the case of lines nearly horizontal, placed at an angle to each other, where there is no stereoscopic effect. The phenomenon shows that when two disparate retinal images are made unequal in intensity, the position of the image resulting from their 'fusion' is shifted towards the more intense image. It should not be confused with Pulfrich's phenomenon of the swinging pendulum. This is dependent upon the delayed perception of weak retinal stimuli, whereas in the present phenomenon a similar time factor is not involved."

Since the first publication, the author has made further observations to ascertain whether or not the reduction in depth effect corresponds exactly to the lateral displacement described. He has confined his investigation to the effects produced by linear images which are angularly disparate, since changes in convergence have no important influence on this type of images. He states that the results obtained, however, are directly applicable to lateral disparateness of any kind.

For his study, he constructed a special apparatus which is described in detail. His conclusions are interesting. When the luminosity of one disparate retinal image, *A*, is reduced below that of the other retinal image, *B*, the effect on the apparent position of the object as regards lateral displacement and depth is the same as would result from a displacement of *A* toward *B* when their luminosities were equal. The effect is directly proportional to the amount of disparateness, and when there is no disparateness, there is no effect. In the case of normal eyes, with black lines 4 mm. wide, angularly disparate, at a distance of 1 meter, and with illumination of the white background equivalent to 68.4 foot-candles, a reduction of 96.8 per cent in the illumination of one image has the effect of reducing

the disparateness about one third, and a reduction of 80.4 per cent has the effect of reducing the disparateness about one fifth. The effect is increased by reducing the width of the lines. The author believes that the effects described must be given consideration in any theory of stereoscopic vision.

SPAETH, Philadelphia.

HEADACHE AND PAIN IN INFLAMMATION OF NASAL SINUSES. WILFRED HARRIS, Brit. M. J. 1:551 (April 1) 1933.

Harris comments on the difficulty of distinguishing the cause of headaches which are amenable to physical intervention from those which are not. The periodicity of frontal sinusitis, commencing at 9 or 10 a. m. and lasting to late afternoon, may simulate a migraine or may even be mistaken for paroxysmal neuralgic tic. Two cases are reported of abscess of the frontal lobe following infection of the frontal sinus.

The radiation of pain far beyond the territory of the actual nerve trunk affected makes diagnosis difficult. For example, an aching molar tooth may cause referred pain upward or downward to the upper or lower jaw, or to the ear, and, if unrelieved, the pain may spread to the neck and down the arm to the fingers of the same side. Harris emphasizes that in high-strung neurotic persons referred pain spreads more widely and readily, but it is important to remember that referred pain does not spread across the middle line. When, therefore, general headache is complained of in inflammation of a sinus it may be assumed that either general toxemia is present or else that there is bilateral involvement of the sinuses. The theory that sensory painful impressions may be carried centrally along sympathetic fibers is not acceptable to the writer.

Facial psychalgias are fairly common and are frequently mistaken for and treated as cases of tic douloureux. True trigeminal neuralgia may have its origin from an infected antrum. Two common forms of pain in the face which may be mistaken for that of chronic sinusitis are: (1) migrainous neuralgia and (2) chronic neurosis of the jaw. In the former, there is a regular periodicity, every few weeks, perhaps accompanied by nausea and lasting for from twenty-four to forty-eight hours. In addition there may be a history of migraine in near relatives and frequently typical hemicranial attacks with vomiting and teichopsia.

Chronic neurosis of the jaw is an atypical neuralgia, almost limited to women of reproductive age and mainly psychalgic in origin. The pain is constant, affecting mainly the cheek and maxillary region on one side only, and is unaffected by movements of eating or by handling the face. It is always present during the waking hours, and as a rule sleep is not interfered with. Sometimes flushing and even slight swelling of the cheek may be complained of. Local treatment for this condition is to be discouraged. Many of the cases can be traced to some nervous shock. In regard to the latter group the author remarks: The frequency of cranial, and especially facial psychalgias, may be explained by the natural reference of one's "ego" or individual personality to the region of the eyes and face, which more than any other part of the body express the emotions. The observation is made that amongst the blind St. Dunstan's men, who are especially liable to neurasthenia, their neurasthenic headaches are always referred to the cranium, and no case of facial psychalgia has been observed among them.

FERGUSON, Niagara Falls, N. Y.

ANTEROLATERAL CHORDOTOMY FOR INTRACTABLE PAIN. EDGAR A. KAHN, J. A. M. A. 100:1925, 1933.

The author states that chordotomy has been performed in the clinic of Dr. Max Peet on seventy-eight patients by Peet, Allen and himself. He believes that the outstanding indication for chordotomy is intractable pain associated with malignant disease. He has performed chordotomy on thirty-three patients for malignant growths of the uterus, prostate gland and large intestine. The pain of bone metastasis is perhaps the severest of all. He has performed the operation in two

patients for ulcerative cystitis with good results. Other indications are the gastric crises and lightning pains of tabes, phantom limb, osteoarthritis and traumatic lesions of the spinal cord or of the brachial or lumbosacral plexuses. Even intolerable itching can be relieved by this operation, although he has never operated for this alone. He believes that local anesthesia is the anesthetic of choice. During the last few years, however, most of his patients have been operated on under tribrom-ethanol anesthesia. Recently the length of the incision has been shortened and  $2\frac{1}{2}$  inches (6.4 cm.) has been found to be sufficient in slender persons. His technic is as follows: Two laminae are removed, but the laminectomy must be wide for proper rotation of the cord. The dura should and usually can be opened without nicking the underlying arachnoid. If a thickened arachnoid adherent to the cord structures is encountered, hemorrhage may result, since the arachnoid must be stripped from the anterolateral column before the cord can be incised. This usually stops readily on the application of cotton pledgets. The arachnoid is always incised laterally. This lateral incision leaves the arachnoid intact over the posterior part of the cord and undoubtedly aids in preventing the formation of adhesions. The dentate ligament is grasped and its dural attachment divided. Rotation of the cord is accomplished by traction on the dentate. If rotation is difficult, division of a posterior nerve root may make this easy. This should be avoided if possible in the region of the eighth cervical and first dorsal segments, since an area of true anesthesia may be produced in the hand. If the dentate ligament does not suffice for rotation of the cord, this may be accomplished by traction on an adherent arachnoid or a divided anterior nerve root. A pointed knife with bone wax, marking off from 3 to 5 mm., is then inserted at the line of dentate attachment and made to emerge through an anterior nerve root. The blade should enter parallel to the axis of the transverse diameter of the cord to avoid injury to the pyramidal tract. The arachnoid must be removed over the area of cord to be incised. If this is not done, it requires force to enter the knife blade into the cord substance, resulting in tearing off of the dentate ligament from the cord and even damage to the cord itself. An avascular area is chosen, if possible, for the line of incision. If an avascular area cannot be found, the vessels in their pial attachment may be carefully freed from the cord substance.

EDITOR'S ABSTRACT.

PRESBYOPHRENIA. A. BOSTROEM, Arch. f. Psychiat. 99:609, 1933.

Since the days of Wernicke, presbyophrenia has been recognized as a special form of senile psychosis. The attempt to delimit this disease and to establish a definite syndrome, however, has resulted in descriptions by different authors which show a good deal of variation. Fischer thought that this psychosis was associated with special features in the histologic picture of the brain, but subsequently it was shown that the changes described by Fischer are present in other types of senile dementia, such as the Alzheimer type and simple senile deterioration, and in the brains of normal people who have reached a certain age. The author describes twelve cases of this syndrome; he attempts to establish a specific syndrome with certain features in the clinical picture and in the prepsychotic personality.

The clinical picture is characterized by the occurrence of pronounced disturbances in retention and memory, with a fairly good insight and with attempts at confabulations in covering up the memory disturbances. There is little interference with judgment and comprehension. The personalities of these patients are usually fairly well preserved. In their general behavior the most pronounced feature is that of hypomanic-like increase of activity without manic associations. The patients show good contact with their environment and a warm emotional response, which oscillates between friendliness and irritability. The history of such patients usually shows the presence of cyclothymic features in the family and, in some cases, the presence of manic-depressive psychoses. The premorbid personality is characterized by cheerfulness, energetic activity, good adjustability



and, in general, the vivaciousness that is characteristic of the syntonic types. One hardly ever finds schizoid traits in the personality of these patients. Physically, eight of the twelve patients were of the pure pyknotic type, and two, of the pyknotic-athletic type; one had distinct pyknotic leanings, and only one did not present pyknotic characteristics. The patients were all of an advanced age (about 80) and of the female sex. Five of the twelve showed definite signs of arteriosclerosis, and the diagnosis of cerebral arteriosclerosis made for two of these patients was corroborated at autopsy. In seven of the cases there were no definite signs of arteriosclerosis, and postmortem examination in one of these did not show any arteriosclerotic changes in the brain. The author concludes that presbyophrenia is a special type of senile psychosis characterized by the presence of certain symptoms and the absence of others usually found in senile psychoses. Furthermore, the family history and personality analysis show a definite tendency toward the syntonic-pyknotic type.

MALAMUD, Iowa City.

AN EXPERIMENT IN THE GROUP TREATMENT OF PATIENTS AT THE WORCESTER STATE HOSPITAL. L. CODY MARSH, *Ment. Hyg.* **17**:396 (July) 1933.

A survey of a year's work in the reeducation of patients and hospital personnel is given by Marsh. Lectures on mental hygiene and group psychotherapy are given to hospital officials and employees. Response was good from all groups except the attendants. Marsh believes that the ordinary attendant in a state hospital is an anachronism and should be replaced by a socially-minded ward counselor, analogous to the familiar camp counselor or hotel host. Attendants of the present type should be used as porters or ward maids only; they should be permitted no control over the patients. The nonmedical hospital officials were told in group lectures that their job was to cure patients in the course of doing their own work. This task was made attractive and inspiring. Nurses were given special lectures in group leadership. They were taught how to organize community singing and group calisthenics. Having been trained for this type of work, they were inspired to return to their wards and conduct setting-up exercises and ward song-fests; they were taught to encourage the patients to keep better groomed, to organize and lead entertainments and to act as morale officers and community leaders generally. The occupational therapists were taught that their field of activity was the whole hospital compound and not the special shops over which they formerly presided. The interns were given courses in public speaking and in the courteous and cheery reception of new patients.

The chief morale-builder of Marsh's set-up was the morning assembly for quiet patients. The program consisted of singing, reading and discussion of current events. The songs were lively and tender, and the response from the patients was gratifying. The talks were given by doctors, nurses, attendants and officers and, at times, even by patients. Paroled and discharged patients occasionally returned to the assemblies to renew their old contacts. The program was broadcast on an intramural radio system. A special assembly for disturbed patients was also held, with soft and sentimental music as the chief items of the program. In addition to the usual entertainments which every psychopathic hospital provides for its patients, special features were established for the "back wards," while every effort was made to uncover and encourage talent among the patients. A special program of athletics and group educational play was worked out for juvenile patients. A lively dancing class was instituted for the adolescent female patients, with the assistance of high school girls from the town. A discussion group was instituted in every ward. A special lecture course was offered to the relatives of the patients. Finally, every method was employed to make the hospital truly an institute of human relations.

DAVIDSON, Newark, N. J.

THE WHITE CELL COUNT IN DYSTHYMIA. EMILIO RIZZATTI and VITTORIO MARTINENGO, *Riv. di pat. nerv.* **42**:305 (Oct.) 1933.

Completing their previous work on the white cell count in schizophrenia, the authors studied the white cell count in manic-depressive psychoses. They review



the literature on the subject and quote Buscaino as stating that the data are as yet uncertain. They also quote Tinel, who studied the correlation of the blood elements with the vegetative nervous system and who believed that there is a certain correlation between the tonus of the vegetative nervous system and the stages of depression and anxiety. Tinel thought that in depression, as well as in schizophrenia, there is often considerable diminution in the white blood count, particularly of the neutrophilic elements, whereas in manic conditions there is increased polynucleosis, so that by study of a blood smear a state of agitation or depression can be established.

From a study of 100 cases of manic-depressive states, Rizzatti and Martinengo report an increase in lymphocytes, a decrease in neutrophilic leukocytes and a shift of the Arneth formula. The neutrophils are diminished in 75 per cent of cases, whereas the lymphocytes are increased in 80 per cent. The increase in lymphocytes is mainly represented by a small type of cells. The eosinophils are generally present in normal number, though occasionally they are increased. The formula of Arneth, considering a normal index as being between 2.6 and 2.8, seems to be deviated to the left in 20 per cent of the cases, to be normal in 35 per cent and to be deviated to the right in 45 per cent.

This condition of the blood in manic-depressive psychoses contrasts with the condition of the blood in schizophrenia in its early stages, and particularly in the hebephrenic and catatonic types, in which the authors have found slight leukocytosis with slight neutropenia, monocytosis and shift to the left of the formula of Arneth. The nuclear inversion of Velez, present in 50 per cent of cases of schizophrenia, is present in only 5 per cent of manic-depressive cases. No essential differences were observed between the acute and the chronic phase or between the manic and the depressed stage.

The authors review the literature as to the influence of the vegetative nervous system and endocrine conditions in blood counts, and because manic-depressive patients are considered by numerous authors to be suffering from a dysendocrine condition, they believe that the hematologic variations reported must be correlated with a dysendocrine factor.

FERRARO, New York.

PIGMENTATION OF THE OPTIC NERVE. ALGERNON B. REESE, *Arch. Ophth.* 9: 560 (April) 1933.

This article deals mainly with the occurrence of uveal pigment in the form of chromatophores in the lamina cribrosa, as a normal physiologic variation. The establishment of this fact is considered a reason for anticipating in the disk any manifestations of pigment encountered otherwise in the uveal tract. Other forms of pigmentation are discussed, including those arising from the pigmented epithelium, from hematogenous granules of pigment and from siderosis. In addition, several conditions simulating a pigmented disk are mentioned.

Ophthalmoscopically, the lamina cribrosa, while potentially a pigment-bearing tissue, appears most commonly unpigmented. This may be explained by the fact that the peripheral portions of the lamina cribrosa, which are not only more often pigmented but also more densely pigmented than the central portions, are hidden from view by the opaque glial tissue, which constitutes the stroma of the nerve fibers of the disk. This has been demonstrated microscopically before. Pigmented epithelium may also extend a short distance into the disk. Ophthalmologically, this is seen rather often. It is probably an actual migration of pigment cells along the lamina vitrea when the latter does not terminate at the nerve margin but penetrates a short distance into it.

When hemorrhage occurs in the vaginal space about the optic nerve, in the orbit or even in the globe, it will undergo hemolysis, and the granules of pigment will be deposited, either free or phagocytosed, in the nerve. This pigment does not appear in the stroma of the nerve fibers but in the interstices between the nerve fiber bundles where vascularity, and therefore absorption, is at a minimum.

When the demarcation between the margin of the disk and a temporal conus is indistinct and the pigment of this conus is marked at the periphery of the disk, while the conus itself is relatively pigment-free, it may appear, in a cursory ophthalmoscopic examination, as though the pigment is in the periphery of the disk. Further, when the optic nerve has a congenital crater-like hole, which is probably a true deep coloboma of the disk, this crater-like hole may appear dark and simulate pigmentation. It is also not uncommon to find pigmentation of the disk lying in the region of the medullated nerve fibers. It is probable that its appearance is due only to the effect of contrast.

The paper is well illustrated by ophthalmoscopic pictures and microscopic slides of great interest.

SPAETH, Philadelphia.

TRANSITORY CEREBRAL MANIFESTATIONS IN INFANTS AND IN CHILDREN.  
ABRAHAM LEVINSON, J. A. M. A. **101**:675 (Sept. 2) 1933.

The author studied the acute transitory cerebral manifestations in fifty infants and children. The youngest patient was 2 months old, and the oldest, 13 years old; 82 per cent of the patients were boys. He calls attention to the occurrence of ptosis and hemiplegia as transitory manifestations. However, the most frequent symptoms were positive Brudzinski, Babinski and Kernig signs, rigidity of the neck and convulsions. The manifestations usually lasted from twenty-four to forty-eight hours. The underlying causes were pneumonia, infection of the upper respiratory tract, otitis media, pyelitis and rheumatic fever. In three cases no underlying cause could be found. The localization of pneumonia was mainly in the left lower lobe. The blood calcium and phosphorus were normal. The blood sugar was increased in most cases. The cerebrospinal fluid was increased in amount and pressure. The cells were usually normal, and the sugar content was increased in most cases. The cerebrospinal fluid changes are explained by certain blood changes, such as hypotonicity of the blood and increased blood dextrose. The interpretation of the cerebrospinal fluid cell count and sugar is of importance. A normal cell count indicates no meningeal reaction; an increased cell count signifies some meningeal reaction. A normal or even high sugar content, however, does not necessarily rule out an early meningitis, as the cerebrospinal fluid sugar may be increased early in the disease. The diagnosis is difficult. The mode of onset, the physical examination, associated disease and the subsidence of the symptoms in from twenty-four to forty-eight hours are helpful. Respiration is a point in differential diagnosis from meningococcic meningitis. The presence of petechiae speaks for meningococcemia. When no diagnosis can be made by clinical examination, a spinal puncture may be resorted to without fear of producing septicemia. A thin needle should be used and a small amount of fluid withdrawn for diagnosis. No spinal puncture should be done during convulsions. The treatment cannot be generalized. In some cases no treatment is necessary. In others spinal puncture must be resorted to. Intramuscular injections of 10 per cent magnesium sulphate have been found of value for the relief of convulsions. The pathologic process, if any, cannot be determined, because the patients recover. Most likely there are no uniform pathologic changes. Edema of the brain undoubtedly exists in all cases. Constitution may be a factor in the production of the symptoms.

EDITOR'S ABSTRACT.

RETRACTION SYNDROME. RUDOLF AEBLI, Arch. Ophth. **10**:602 (Nov.) 1933.

The retraction syndrome is a name applied to a group of cases in which there is a congenital deficiency of motility of the horizontal rectus muscles. Numerous isolated cases have been reported. The first complete account was presented by Wolff in 1900. Cases presenting this syndrome are characterized by some or even all of the following peculiarities: (1) complete or, less often, partial absence of abduction in the affected eye; (2) partial, rarely complete, deficiency of adduction in the affected eye; (3) retraction of the globe when the eye is adducted, rarely

when it is abducted; (4) an oblique movement of the affected eye either up and in or down and in when the impulse to adduct is exercised; (5) narrowing of the palpebral fissure in adduction with a tendency to widen in abduction; (6) paresis or marked deficiency of convergence, the affected eye remaining fixed in the primary position while the sound eye is converging.

The anatomic basis of these disturbances of motility has been determined by both microscopic and macroscopic examination. There is more or less complete absence of muscular tissue, and the fasciculi of the muscles are replaced by inelastic fibrous bands. Instances of anomalous insertion of the internal rectus muscle, associated with a broad fibrous band intimately attached to the sclera back of the equator, have been reported, but the writer and his associates believe that these are not true cases of retraction syndrome but belong to the group of strabismus fixus; further, they did not include them in their analysis and study.

The essential features of this syndrome are outlined and discussed, especially the retraction movements and the oblique movements which are so characteristic. Six cases are reported. The only treatment considered is surgical. In view of the pathologic condition which underlies most of the cases, advancement of a muscle, which causes an increase in the tension and, hence, in the retraction, may do more harm than good. Moderate recession of the internal rectus seems to be of assistance in patients with relatively good near point convergence. Patients with a marked vertical upshooting may be helped by tenotomy of the inferior oblique muscle. In general, one must be reluctant to operate on patients with this type of anomaly, even though there is no other treatment available.

SPAETH, Philadelphia.

THE PRESSURE AND CHEMISTRY OF THE CEREBROSPINAL FLUID BEFORE AND AFTER THE REMOVAL OF LARGE QUANTITIES OF FLUID AND THEIR RELATIONSHIP TO CERTAIN DRUGS. K. HAUG and L. GÖTTKE, *Arch. f. Psychiat.* **99**:426, 1933.

The investigations reported in this paper were undertaken to ascertain the relationship of the regeneration of the spinal fluid to the blood-cerebrospinal fluid barrier and also to determine the influence of certain drugs on both of these. Thirty-seven experiments were carried out; the results were: 1. The composition of fluids removed from different parts of the canal shows marked variations. On the whole, the concentration of both crystalloids and colloids is greater in the lumbar than in the cisternal fluid. 2. The time of regeneration after the removal of fluids depends on the quantity removed, and for from 40 to 65 cc. it ranges from three to six and one-half hours. The speed of regeneration can be influenced by certain drugs, and this regeneration has a special relationship to the permeability for bromides. Without the administration of drugs, the speed of regeneration is directly proportional to the permeability; that is, with high permeability the regeneration is more rapid, and vice versa. Calcium causes decreased permeability and a decreased rate of regeneration. The same is true of phenobarbital. Atropine causes increased permeability but a decreased rate of regeneration. Theophyllin-ethylenediamine causes decreased permeability and an increased rate of regeneration. Methenamine causes increased permeability but does not tend to influence to any extent the rate of regeneration. A preparation containing solution of pituitary causes decreased permeability with a decreased rate of regeneration. During treatment with a fever-producing drug, the permeability and the rate of regeneration are decreased. The fact that the rate of regeneration and the permeability for bromides may be equally affected by some drugs but influenced in opposite directions by others tends to show that these functions are not always directly related. The authors conclude that their investigations point to the fact that the permeability for bromides as well as for other substances cannot be explained purely on the basis of dialysis but must be partly dependent on physiologic activities of the cells of the membranes.

MALAMUD, Iowa City.

IS THERE A HUMORAL SYNDROME OF ECHINOCOCCUS CYST OF THE BRAIN?  
CRISTOFORO RIZZO, Riv. di pat. nerv. **42**:283 (Oct.) 1933.

According to statistics from the department of pathology of Cagliari University, cysts of Echinococcus were found in 45 of 1,724 autopsies, or 2.55 per cent. According to Putzu, cerebral localization of the echinococcus occurs in only 0.75 per cent of cases, and according to Graziani, in 2.5 per cent. Statistics collected from South America and Australia by Lombard point to a cerebral invasion by the echinococcus in 3 per cent of cases. The rarity of involvement of the brain contrasts with the frequency of localization in the liver—52.5 per cent according to Putzu and 74.9 per cent according to Deve.

Primary cerebral invasion by the echinococcus seems to affect principally persons less than 15 years of age, whereas metastatic complications are found in subjects over that age. Metastasis to the brain, according to Deve, is the result of a primary cyst of the heart. While primary infestation is represented by a single cyst, metastatic invasion results in several small cysts.

Because Rizzo believes that a definite diagnosis of the presence of *Cysticercus cellulosus* can be made only through laboratory investigation, and particularly by the discovery of eosinophilia in the cerebrospinal fluid, he investigated the usefulness of examination of the cerebrospinal fluid in cases of echinococcus cyst of the brain. In only a few cases reported in the literature has the cerebrospinal fluid been examined. Frederici reported normal cytologic characteristics of the cerebrospinal fluid in his case. In a case of Lombard there was considerable lymphocytosis. In the cases of Lagos Garcia, Foresti, Bonaba and Aievoli, the cerebrospinal fluid was normal. Ayala and Pisani also reported normal cerebrospinal fluid in cases of echinococcus cysts.

In one of two cases reported by the author, the cerebrospinal fluid presented only a definite increase in lymphocytes. The author therefore concludes that eosinophilia, which is so important in the diagnosis of the presence of *Cysticercus*, is not present in cases of echinococcus cysts and that there is no specific humoral syndrome for the infestation of the brain with the latter.

FERRARO, New York.

THE NEUROFIBRILLAR STRUCTURE OF THE FIVE AND ONE-HALF MILLIMETER  
CAT EMBRYO. WILLIAM F. WINDLE, J. Comp. Neurol. **55**:315 (Aug.) 1932.

A 5.5 mm. embryo of a cat was available for this study. It was prepared by the Ranson pyridine silver method. The regions of the oculomotor and trochlear, trigeminal, facial and acoustic, glossopharyngeal, vagus and accessory nerves and the spinal cord are described.

The motor nuclei of all cranial nerves arise from a single longitudinal column of neuroblasts located in the basal plate on either side of the median line. The visceral nerves arise from the most medial part of this column and the somatic nerves from the lateral part of it. The column is interrupted completely between the oculomotor and trochlear and incompletely between the trochlear and trigeminal nuclei. The motor portion of the facial nerve is not so well developed as the more rostral and caudal nerves. Crossed components of the oculomotor and facial nerves seem to be present; the trochlear nerve has not reached the tegmental plate. No continuous primary sensory pathway is present. Sensory root fibers of the trigeminal, facial, glossopharyngeal and vagus nerves form short descending tracts. The fibers which belong to the trigeminal and facial nerves have the longest course. A few vestibular nerve fibers reach the brain, but do not form a distinct pathway there. The two main descending secondary pathways are the medial and lateral longitudinal fascicles, both of which are predominantly homolateral tracts in the rostral part of the brain. Two portions of the medial longitudinal fascicle are distinguishable. The rostral part arises from neuroblasts rostral to the oculomotor nucleus and descends on the same side to the middle of the facial nucleus. The caudal part arises from neuroblasts of the mantle layer of the lower part of the rhombencephalon and spinal cord. It appears to be predominantly a contralateral ascending pathway.

It is largest at the level of the hypoglossal nerve, ends at the facial nucleus and is not present below the upper thoracic spinal cord. The lateral descending pathway arises mainly in the alar plate of the mesencephalon and ends in the lower rhombencephalon.

FRASER, Philadelphia.

**FORCED DRAINAGE OF CEREBROSPINAL FLUID: ITS EXPERIMENTAL BASIS, TECHNIC OF CLINICAL APPLICATION, AND INDICATIONS AND CONTRAINDICATIONS.** LAWRENCE S. KUBIE and GEORGE M. RETAN, *J. A. M. A.* **101**:354 (July 29) 1933.

The authors summarize their studies on the clinical results of forced drainage of the cerebrospinal fluid in infectious diseases of the central nervous system as follows: 1. A trial of this procedure is indicated in the presence of any acute or chronic infection of the central nervous system; but it is contraindicated whenever an intracranial lesion is suspected into which fluid can be poured without opportunity for free escape, in the presence of cardiorenal deficiency or in the presence of active inflammatory processes elsewhere in the body. 2. The purpose of all technical manipulation must be to reduce intracranial pressure to atmospheric pressure, rapidly when conditions so permit, or slowly and cautiously when this is necessary, to avoid discomfort for the patient. Throughout this procedure, hypotonic salt solution is administered in large volumes, ranging from 1 to 3 liters in the course of from one to three hours. The concentration of the salt solution varies downward from 0.45 per cent, depending on the fragility of the red cells of the particular patient and the rate at which the fluid is to be administered. The duration of drainage varies from three hours to several days. The frequency of repetition is rarely more than once a week for the short, repeated drainages, but may be maintained continuously over as long as two or three weeks in the face of more desperate and acute infectious processes. 3. The theoretical basis for the method lies in the fact that under these conditions cerebrospinal fluid is formed not only from the choroid plexus but by transudation through all the capillaries of the central nervous system, the new fluid thus formed traveling along perineuronal and perivascular spaces to the subarachnoid space and out through the lumbar needle. This affords a natural process of internal lavage, which influences the accumulation of inflammatory products and the course of infectious processes without increasing intracranial pressure or causing hydration of the parenchymatous tissues.

EDITOR'S ABSTRACT.

**ACUTE OCULAR COMPLICATIONS OF MULTIPLE SCLEROSIS.** J. BOLLACK and KUDELSKI, *Rev. d'oto-neuro-opht.* **11**:95 (Feb.) 1933.

The case of a young woman suffering with multiple sclerosis is reported in detail. The evolution of the disease was in three episodes. The first was represented by paralysis of the left sixth nerve and was not attended by any other neurologic signs. It disappeared after seven weeks. The second episode occurred seven months later and was manifested by retrobulbar neuritis in the left eye, a reduction of vision to 1/50, a large central scotoma and normal eyeground. Vision returned to normal in fifteen days during treatment with salicylates; no other neurologic symptoms were present. The third episode appeared sixteen months after the second and was characterized by total blindness of the left eye without changes of the eyeground. After ten days the blindness slowly improved and was replaced by an enormous central scotoma. After one month the visual acuity was almost normal. The visual troubles were accompanied by stiffness and exaggerated tendon reflexes in the left leg and by diminution of the abdominal cutaneous reflexes. The interest of the case consisted in the polymorphism of the ocular manifestations.

Noteworthy in cases like this are: the unilaterality, the more or less sudden appearance of the ocular troubles, the accompanying periorbital pain, the quite rapid spontaneous regression and the failure of the therapeutic measures. The character of the visual difficulty varies with the different localization of the infective



process. It is characteristic of multiple sclerosis that discoloration of the disk, when present, is compatible with integrity of vision, and that the discoloration is most often total. Optic neuritis may be accompanied by papillitis, and the resulting scotoma or blindness may be partial or complete according to the location of the pathologic process. The appearance of an acute optic neuritis with macular predominance in a young person points to multiple sclerosis when other etiologic factors are not clear, and this inference holds true even with a minimum of or in the absence of other neurologic signs.

DENNIS, Colorado Springs, Colo.

THE GLUTATHIONE CONTENT OF THE BRAIN IN EXPERIMENTAL SLEEP.  
GENEROSO COLUCCI, *Riv. di neurol.* **6**:716 (Dec.) 1933.

The author studied the change in the quantity of glutathione in the brains of forty cats after producing experimental sleep by the subcutaneous injection of sodium phenobarbital. Some of the animals were killed after five hours of sleep and others after eight hours. The food intake of the animals was identical during the period of observation. The same quantity of brain substance, 3 Gm., was studied for all animals, the substance being taken from the cortex and the mesodiencephalon. The methods used for the determination were two slight modifications of the procedure of Tunncliffe. The two methods showed consistent differences of about 25 per cent. The first modification, giving the higher glutathione content, consisted of a titration with iodine alone, and the second method, giving values about 25 per cent lower, consisted of retitration with thio-sulphate. However, during the period of experimental sleep produced with sodium phenobarbital, the figures indicate a general increase in the amount of glutathione in the brain tissue, the increase being shown by both methods and in the same quantity. In the nonsleeping state, the mesodiencephalic region showed by both methods a slightly lower glutathione content than did the cortex, a difference of about 7 per cent. After five hours of sleep there was an increase of about 7 per cent in the glutathione content of both cortical tissue and mesodiencephalic tissue. At the eight hour stage there was a further increase of about 10 per cent, the increase being the same in general in both specimens of material. The author believes that glutathione, an activator of the oxidation processes in the tissues, accumulates in the brain during sleep. The inherent difficulties of methods for determining the glutathione content, the absence of figures indicating the quantity of control material and the number of cases tested by each method under normal conditions make accurate interpretation of the results difficult.

BARRERA, New York.

FACIAL DIPLEGIA IN LYMPHATIC LEUKEMIA. PAUL H. GARVEY and JOHN S. LAWRENCE, *J. A. M. A.* **101**:1941 (Dec. 16) 1933.

The authors report one case in which leukemia was the cause of facial diplegia and two cases of acute leukemia in which unilateral facial paralysis occurred. The clinical picture in the first case suggested strongly follicular tonsillitis complicated by neuritis of the cranial nerves. The appearance of the tonsils was atypical. This should always suggest the possibility of a leukemic process. The fact that the blood picture at this time revealed no abnormality other than neutrophilic leukocytosis made the diagnosis more difficult. Infiltration of the cranial nerves occurred at a period when there was no increase in the number of lymphocytes in the peripheral blood. This demonstrates that it is possible to have marked increases in the number of cells in localized areas of the body without having their numbers augmented in the peripheral blood. In one of the other cases the onset of the disease was characterized by a predominance of symptoms and signs referable to the nervous system. The paralysis of the cranial nerves developed when the leukocyte count was relatively low and few symptoms of a constitutional disease were present. Studies of the blood were helpful in arriving at an early diagnosis. It was impossible

from the clinical observations to determine whether the paralysis was the result of nuclear or of peripheral nerve involvement. The absence of weakness or paralysis of conjugate deviation of the eyes suggests a peripheral location of the lesion. In the other case the facial paralysis appeared six weeks after the clinical picture of leukemia was well established. Hemorrhagic phenomena in the skin and mucous membranes were prominent symptoms before the paralysis occurred. The nature of the lesion involving the seventh nerve was undetermined, but it seems justifiable to attribute it to the changes found in the cranial nerves in cases of leukemia.

EDITOR'S ABSTRACT.

SOME PSYCHIATRIC ASPECTS OF SUICIDE. GERALD JAMEISON and JAMES H. WALL, *Psychiat. Quart.* 7:211 (April) 1933.

Fourteen instances of suicide by institutionalized patients and eleven by persons paroled from hospitals for mental diseases are reported. No significant difference between the ages of these persons and those of suicide victims generally was noted. The majority of the subjects in Jameison and Wall's series were women, an observation of interest because of the fact that only 25 per cent of the persons who commit suicide throughout the country are females. Irritability, depression, insomnia, anxiety and fear of becoming insane had been noted in most of the subjects in the group studied. Jameison and Wall endeavor to explain the suicidal tendency on an analytic basis, postulating that the diversion of the libido to the self necessarily associated with narcissistic regression results in the development of a strong sadistic impulse. This is further illustrated by the patient's exaggerated fear for the safety of others, considered by the authors as a projected suicide wish and overcompensatory fear. Attention is called to the sense of guilt. Jameison and wall suggest that the fear of insanity is a subconscious wish to destroy inhibitions and return to infantile levels. All of the patients had shown suicidal tendencies, and half of them had made specific suicidal attempts.

Most of the suicides of institutionalized patients occurred during a time when supervision was relaxed. To reduce the number of suicides in institutions the authors suggest: (1) development of a strong transference to the physician; (2) special supervision of patients with suicidal trends; (3) maintenance of vigilance at all times, with special attention to the periods in the hospital routine when this would ordinarily be relaxed; (4) refusal of parole to patients with strong suicidal ideas, and (5) encouragement of suicidally inclined patients to accept a regular schedule of therapeutic activities.

DAVIDSON, Newark, N. J.

ASPECTS OF MOTOR BEHAVIOR OF BIOPATHIC PHRENASTHENIC PERSONS. GIUSEPPE PINTUS, *Riv. di pat. nerv.* 42:47 (July-Aug.) 1933.

In a study of fifty phrenasthenic persons, the author analyzes all the variations of posture, facial expression, walk and other motor habitual or instinctive acts. He emphasizes the similarity that most of these acts have, from the standpoint of the motor outline, to those of patients suffering from other nervous conditions, particularly from chronic epidemic encephalitis.

The author classifies the motor variations recorded in his cases predominantly with extrapyramidal disturbances, though he warns that one must not expect to find from an analytic examination the most elementary symptoms of extrapyramidal conditions, such as the cogwheel phenomenon and the characteristic hypertonia. A wider physiologic and biopathologic conception of the extrapyramidal system should include the congenital and acquired automatisms, as well as attitudes and postures of the body. The author does not feel it justified as yet to refer the motor changes reported in his survey to a definite anatomic localization. He believes, however, that most of the motor disturbances in phrenasthenic persons are of fronto-extrapyramidal origin.

Following the conception expressed by de Lisi in his work on "motor constitution," the author attempts to classify the various motor types of phrenasthenia into three main groups: (1) the slow rigid type, resembling the chronic epidemic

encephalitic and the pithecoïd type of Homburger; (2) the light, agile, slightly rigid, awkward type, resembling the paratonic type of Dupré, and (3) the restless, fast, unprecise, unconvincing type, resembling the type of Gurewitsch. From the standpoint of kinesis, the patients may be classified as hypokinetic, parakinetic and hyperkinetic.

FERRARO, New York.

THE MECHANISM OF THE FISTULA SIGN. F. J. COLLET and R. MAYOUX, *Rev. d'oto-neuro-opht.* **11**:427 (June) 1933.

Two hypotheses explain the fistula sign. The first is that movement of the endolymph causes the nystagmus, and the second is that the fistula sign is an otolithic reaction. Herzog believed that to produce the fistula sign two weak points in the labyrinth capsule were necessary: the fistula and the fenestra rotunda. Most often the compression acts through the fistula, and nystagmus toward the diseased side is produced; if the force acts through the fenestra rotunda, the nystagmus is toward the healthy side.

Two cases are recorded. In the first, of a patient with a perforation of Shrapnell's membrane of the left ear, compression produced nystagmus with the slow component to the right; aspiration reversed the nystagmus. Thirty days later the same procedures produced opposite directions of the nystagmus. The second case was that of a man who had had a radical operation on the mastoid on the left side. Compression with the Siegle speculum produced nystagmus to the left, while aspiration caused poorly marked movements of the slow component to the left. Direct pressure on the horizontal canal produced marked nystagmus to the left (slow component to the right); decompression caused slight slow movements to the left. Direct pressure over the fenestra rotunda produced slight movements (slow component) to the right; decompression caused distinct nystagmus to the right (slow component to the left). The direction and the intensity of the nystagmus conformed to Ewald's experiments. These observations support the conclusion that change in the direction and intensity of nystagmus from compression and aspiration may be explained by a current of endolymph toward or away from the ampullae.

DENNIS, Colorado Springs, Colo.

PATHOLOGIC ANATOMY AND PATHOGENESIS OF SO-CALLED SYPHILITIC SYSTEM DISEASES OF THE CENTRAL NERVOUS SYSTEM. M. AMMOSSOW and N. MASJILLO, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **141**:30 (Aug.) 1932.

Syphilitic system diseases may assume various forms. Ammosow and Masjillo report cases of several types, which include tabes dorsalis complicated by cerebellar symptoms and signs of disease of the pyramidal tracts, cerebellar ataxia with signs of involvement of the pyramidal tract and amyotrophic lateral sclerosis. In the tabetic cases there was degeneration of the dorsal columns and pyramidal tracts, as well as of the inferior olives. The latter were especially affected. Meningeal and vascular syphilis was pronounced. Serologic tests were strongly positive. In the case of cerebellar ataxia there was degeneration of the pyramidal tracts, the inferior olives, the dentate nuclei and the substantia nigra. There was marked meningovascular syphilis, with parenchymatous changes. The case of amyotrophic lateral sclerosis was typical. The muscles of the shoulder girdles, arms and hands were particularly atrophied; those of the lower extremities were less involved. Signs referable to the pyramidal tracts were pronounced. The pupils were small and reacted weakly to light. The Wassermann reaction of the blood and spinal fluid was negative. There were no changes in the cell count or the colloidal gold curve of the spinal fluid. Necropsy showed marked changes of the pyramidal tract with loss and degeneration of the cells of the anterior horns, especially in the lower part of the cervical portion of the spinal cord. The entire spinal cord showed marked pial fibrosis, with infiltration by round cells and plasma cells. The anterior spinal artery showed a typical Heubner type of endarteritis. The meningovascular changes are regarded as primary.

ALPERS, Philadelphia.

## VISUAL FIELDS WITH MINIMAL LIGHT STIMULUS. LEO L. MAYER, Arch. Ophth. 9:353 (March) 1933.

The author's aim in this study was to determine the reaction of the peripheral portions of the normal retina to light stimuli of minimal duration. In a brief review of some of the literature, he mentions the work done by Förster in 1853, and by von Graef in 1856, and then carries the discussion and literature through to some of the most recent work from the Wilmer Ophthalmic Institute.

In describing the apparatus and methods used, Mayer emphasizes the necessity for a device of some kind that is capable of emitting a flash of light of extremely short duration, i. e., of the order of  $10^{-4}$  second or less, and one which would limit the emission to a single flash. He describes in detail one that was evolved with the assistance of Mr. S. F. Gaddas. The results obtained are tabulated only for the horizontal meridian. Fatigability was not analyzed, but sufficient time was allowed to lapse between each step of the test to allow for retinal recovery and for the disappearance of any after-image. The results were slightly variable, but they ranged from the utilization of from ten flashes in six seconds, or a single flash of  $\frac{1}{33,000}$  second, to 10 flashes in approximately fifteen seconds, or a single flash of  $\frac{1}{13,000}$  second. In this way there has been established for the horizontal temporal axis a normal light stimulus value in terms of duration, in a time quality, for the 50 to 65 degree angles of the peripheral field. Further examinations in the various meridional axes can establish a complete field, having the same duration values, for the average of normal.

The apparatus used was so built that the instigating flashes were not visible at all times in all the meridians, i. e., varied from 55 to 80 degrees, and as the more peripheral meridians were approached the flash was lost at even the lesser speeds, the least being most peripheralward.

SPAETH, Philadelphia.

## EXPERIMENTAL OBSERVATIONS UPON THE DEVELOPING RAT RETINA. S. R. DETWILER, J. Comp. Neurol. 55:473 (Aug.) 1932.

Litters of rats reared in the dark and litters reared in the light were studied from birth to 18 days, with an attempt to correlate the first appearance of granules of secretion in the rods of the fixed retina with the first appearance of visual purple in the fresh retina. Other features of the general development and differentiation of the retinal elements are described. In the rat the lids separate usually on the fourteenth or fifteenth day after birth.

Litters of rats reared in the dark and litters reared in the light show no measurable difference in the rate of development of the retina at these ages. The retina is poorly developed at birth, with no evidence of differentiation of visual cells. The external and internal nuclear layers exist as a single broad zone of nuclei, along the choroidal border of which extensive mitotic activity takes place until six days after birth. During the first two days after birth, no perceptible development takes place. The visual cells develop very slowly until the tenth or eleventh day after birth, but from then on development becomes greatly accelerated until the sixteenth day, after which growth is again slow.

Visual purple in the fresh retina adapted to darkness becomes definitely visible twelve days after birth. At this period the outer segments of the rods, when suitably prepared, show the presence of granules which stain deeply. As the eyes become fully differentiated, many granules are seen outside the rods in eyes adapted to darkness. In eyes adapted to light, although the granulations are much less abundant outside the rods, they are generally more pronounced within these elements than in the eyes adapted to darkness. It seems apparent that the histologic picture described in the stained retina is bound up with the visual purple function, since it does not occur prior to the time when visual purple is first demonstrable in the fresh retina.

ADDISON, Philadelphia.

MENTAL PHENOMENA OBSERVED IN CASES OF BRAIN TUMOR. GEORGE W. HENRY, *Am. J. Psychiat.* **12**:415 (Nov.) 1932.

From a study of 26 original cases and a survey of more than 1,000 cases of verified tumor of the brain gathered from the literature, Henry has been able to classify mental symptoms according to the localization of the neoplasm, the rapidity of its growth and the degree of intracranial hypertension. The latter causes certain general mental phenomena, such as somnolence, irritability and confusion. In the early stages of the illness, the reactions are determined more by the type of personality affected, but as the disease progresses the manifestations are increasingly those of organic disease of the brain.

Frontal tumors are often associated with euphoria, moria, memory defects, confabulations, incontinence and hallucinations—these more commonly auditory. Temporal lobe growths, contrary to popular opinion, are not as frequently associated with auditory hallucinations as with visual, gustatory or olfactory sensations. No localizing mental signs are noted in parietal neoplasms. In occipital lobe tumors, crude auditory and visual hallucinations may occur. In growths of the cerebellum the mental phenomena are generally those of increased intracranial pressure. Tumors of the corpus callosum tend to resemble those of the frontal lobe in the psychiatric symptomatology. Lesions at the third ventricle and basal ganglia may give rise to involuntary laughing and crying, while somnolence, disorientation and disturbances of memory appear earlier in tumors of the base of the brain than in growths in other parts of the organ. Crude tactile hallucinations are not infrequently associated with tumors of the pons and of the medulla.

DAVIDSON, Newark, N. J.

TRANSPLANTATION OF SPINAL GANGLIA IN THE WHITE RAT. A STUDY OF THE MORPHOLOGICAL CHANGES IN SURVIVING CELLS. CHARLES W. TIDD, *J. Comp. Neurol.* **55**:531 (Aug.) 1932.

An attempt has been made to follow the reaction of transplanted ganglia over long periods of time. None of the previous experimenters on this problem have reported the condition of the cells later than twenty-three days after transplantation. The small size of the ganglia in the rat provides suitable material for this experiment.

Spinal ganglia of young rats were transplanted into the brains of other animals of the same species. Twenty-five successful experiments were performed. The recovered ganglia showing surviving cells were divided into three groups: (1) transplants from 3 to 7 days old; (2) transplants from 27 to 33 days old, and (3) transplants 99 days old. The cells in the transplants of the first group undergo a marked reaction. There is production of innumerable new fibers, both from the cell body and from the axon. Most of the fibers terminate in end-buds. The cells in the second group of transplants show that the reactive phase characteristic of readjustment to the new environment has almost disappeared. Only an occasional end-bud is seen. Most of the cells appear to be of normal size and shape. In the ninety-nine day transplant the cells are of normal size and have assumed again a normal shape. They are unipolar. The location of the ganglia in the brain of the recipient is a factor in the survival of the cells. More cells survived in ganglia which were transplanted into or near the lateral ventricles than in those transplanted into denser portions of the brain in which the nourishing fluids were less abundant. Tidd believes that these cells have adjusted themselves so that they would have survived indefinitely.

ADDISON, Philadelphia.

SEROUS MENINGITIS WITH CEREBELLAR SYNDROME DURING THE SUBSIDENCE OF CATARRHAL OTITIS. G. WORMS, *Rev. d'oto-neuro-opht.* **11**:418 (June) 1933.

In January, 1930, a man, aged 32, had an attack of catarrhal otitis media in the right ear, without eventual suppuration. Shortly afterward, crises, charac-



terized by violent headache, vertigo, nausea and vomiting and loss of consciousness, appeared and had persisted for ten months. Between the crises the patient complained of headache, malaise, vertigo and obnubilation. Examination in January, 1931, revealed dulness, deficient memory, slow cerebration, lack of attention and rapid intellectual fatigue. Neurologic and all other examinations gave negative results except that the right tympanic membrane was slightly bulging in the posterior superior segment and was rosy, the hearing was diminished, and a roentgenogram showed a slight clouding of the right mastoid cells. On March 15, a slight papillary edema, more marked on the right side, was observed; a neurologic examination revealed a left cerebellar hemisindrome (hypermetria and dysmetria of the left leg, adiadokokinesis of the left arm and muscular hypotonia) and hyperexcitability of the left vestibular apparatus. Following two subtemporal decompressions, two weeks apart, and roentgenotherapy, recovery occurred. The interest of the case is the serious intracranial complication, induced by an apparently mild otitic infection. A focus of limited extent (abscess or tumor) in the posterior fossa is suggested, but the results of the decompressions eliminated this hypothesis and resolved the diagnosis into one of a slowly evolving meningeal dropsy.

DENNIS, Colorado Springs, Colo.

DETERMINATION OF THE NUMBER OF UNMYELINATED FIBERS IN THE VENTRAL ROOTS OF THE RAT, CAT, AND RABBIT. DONALD DUNCAN, J. Comp. Neurol. **55**:459 (Aug.) 1932.

An estimate is made of the number of unmyelinated fibers in the ventral roots of the spinal cord of the rat, the cat and the rabbit. The selected nerve roots were removed carefully by a cut close to the cord and another a few millimeters beyond the ganglion. The roots and ganglion from one side were treated with 1 per cent osmic acid, and those from the opposite side were treated by the pyridine silver technic. Counts were obtained of the number of myelin sheaths in the osmicated sections and the number of axis-cylinders in the sections treated with pyridine silver.

The ventral root fibers arising from the thoracic levels of the spinal cord of the mature albino rat are two thirds myelinated and one third unmyelinated, on the average. Very few unmyelinated fibers are present in the cervical, lower lumbar and midsacral ventral roots of the rat. The number of unmyelinated fibers in the thoracic ventral roots of the mature rabbit is approximately one third of the total number of fibers. In the cat the number of unmyelinated fibers in the ventral roots is distinctly less than in the rat. An average of 16 per cent of the total number of fibers in the eighth thoracic nerve of the cat are unmyelinated. On the basis of distribution in the rat, Duncan concludes that most of the unmyelinated fibers in the ventral roots are preganglionic sympathetic fibers which never acquire a myelin sheath.

ADDISON, Philadelphia.

THE BABINSKI PHENOMENON IN INFANTS. M. SCHACHTER, J. belge de neurol. et de psychiat. **33**:180 (Feb.) 1933.

Schachter limits himself to a discussion of the literature, quoting from numerous papers. He believes that until the age of 2 months there is no distinct reaction; from 2 to 3 months, reactions vary from dorsal to plantar flexion of the toes; from 3 to 4 months, dorsal flexion and fanning of the toes occur with occasionally the dorsal flexion changing into plantar flexion at the end of the reaction; from 4 to 6 months, a similar movement of the toes is noted, but is accompanied by a reflex which draws the leg toward the abdomen. The consistent reaction of plantar flexion occurs, according to various authors, between 3 months and 7 years, and after this period the appearance of the primitive formula indicates a pathologic lesion.

In the author's series of patients tested at the age of 5 months there was extension, but the extensor response was never pure, being associated with an added

flexion, or extension and fanning to which is often added flexion of the foot and leg. The response was more active while the child was asleep. Excitation of cutaneous areas away from the sole in several of the cases caused extension of the great toe. This was most marked in a premature child aged 7 months. The author believes that before the age of 2 years the Babinski sign is not an evidence of pathologic change.

WAGGONER, Ann Arbor, Mich.

**DISTURBANCES FOLLOWING LUMBAR PUNCTURE: I. RELATION WITH THE VEGETATIVE NERVOUS SYSTEM.** ARTURO PACIFICO, *Riv. di pat. nerv.* **42:1** (July-Aug.) 1933.

The author has investigated the relationship of the vegetative nervous system to the phenomena that occasionally follow spinal punctures, such as shock, fall of blood pressure, acceleration of the pulse rate and more or less severe headache. The pathogenic mechanism of these disturbances has been discussed by various authors from a physiologic or biologic angle but has not as yet been sufficiently elucidated. From a survey of the literature and his own clinical material, the author concludes that in the determination of disturbances following spinal puncture there undoubtedly is an important factor represented by the neuro-vegetative constitutional make-up of the patient.

Pacifico thinks that in cases in which hypotonia of the neurovegetative system is disclosed by the Danielopolu and Carniol test the aforementioned disturbances are generally missing, whereas they frequently appear in cases of normal or increased tonus of the neurovegetative system; they are particularly frequent in the cases that can be classified as "alternate neurotonia of Guillaume" or "dystonia of Castellino." The author thinks, however, that his data are not complete and that other investigations must be carried out to correlate modification of the tonus of the vegetative nervous system with other biochemical or physiologic factors that are also involved in lumbar puncture.

FERRARO, New York.

**FURTHER EXPERIENCES CONCERNING CLINICAL ASPECTS OF THE BLOOD-CEREBROSPINAL FLUID BARRIER.** C. BAUMANN, *Monatschr. f. Psychiat. u. Neurol.* **81:241** (Jan.) 1932.

Baumann reports the results of an investigation of the blood-cerebrospinal fluid barrier with Walter's bromide test in 119 cases. There were 15 cases of manic-depressive psychosis, 12 of schizophrenia, 12 of dementia paralytica and 8 of the tabetic form of dementia paralytica and smaller groups made up of other types of mental disorder. A group of cases of miscellaneous neurologic conditions is also included. Values between 2.7 and 3.5 for the distribution ratio of bromide were accepted as normal. In manic-depressive psychosis and schizophrenia most of the figures were within normal limits. Hence the author does not believe that the Walter test is of value in differentiating between the two disorders. In neurosyphilis an increased permeability to bromide was regularly found. In Baumann's opinion, this is a result of the disease rather than the cause of it. Following treatment with malaria, the distribution ratio of bromide moved in the direction of normal in clinically improved as well as in unimproved patients. In cerebral arteriosclerosis and senile psychoses an increased permeability to bromide frequently occurred. According to Baumann, the bromide test may provide useful information in obscure neurologic conditions. Thus, normal results in doubtful cases tend to exclude the diagnosis of neurosyphilis.

ROTHSCHILD, Foxborough, Mass.

**THE NEUROPSYCHIATRIC MANIFESTATIONS OF CHRONIC MERCURY POISONING.** O. T. VULFOVSKY and F. A. POPOV, *Sovet. psikhonevrol.* **9:48** (Jan.) 1933.

One hundred and fourteen employees with signs of chronic mercury poisoning in a large industrial plant were studied by the authors. There is much variation in the individual susceptibility to mercury. Some patients show only slight evidences of intoxication, even though they have been employed in the trade for five

or six years, whereas others show symptoms of grave poisoning after being in the factory for only two or three weeks. The resistance to poisoning is greatest in athletic, well nourished, well developed persons. The most common neuro-psychiatric symptom is emotional instability. The patients complained of being irritable, cranky, mean, cruel and impulsive. Slight stimuli caused violent outbursts of anger, with the patient shaking all over. Retentive memory was impaired in about one third of the cases. The authors describe a "polarity" of some of the symptoms; for example, some patients complained of insomnia, while others stated that they slept too much. The same "polarity" was observed in the field of sex drive. The authors believe that the tremors which are so characteristic of mercury poisoning are due to involvement of the basal ganglia, as they are much like those observed in epidemic encephalitis. The various vasomotor disturbances and the subjective complaints of neurocirculatory asthenia are also due to involvement of the same areas in the brain.

KASANIN, Howard, R. I.

TRANSFUSIONS IN THE TREATMENT OF MALARIA. RALPH G. REED, *Psychiatric Quart.* 6:441 (July) 1932.

Many persons suffering from dementia paralytica cannot receive the benefits of treatment because they have middle ear disease, nephritis or other conditions which forbid the use of quinine. If some method other than the administration of quinine could be found for the cure of malaria, the advantages of fever therapy could be extended to this group. On the theory that persons who have a natural or acquired immunity to malaria carry in their blood streams some plasmodicidal agent, Reed attempted to stop the chills and fever of induced malaria by transfusions of blood from these persons. The donor was a person who had been unsuccessfully inoculated three or four times and whose blood plasma, therefore, was presumed to contain properties unfavorable to the development of the plasmodium. Nineteen patients were treated by transfusions of whole or of citrated blood from immune donors. In some cases the chills were diminished; in some the interval between the chills was lengthened, while in some the chills ceased but the blood smears showed repeated positive stains for the organisms of malaria. Judging from the results, therefore, Reed is forced to conclude that blood transferred in permissible amounts from a person who cannot be successfully inoculated with the plasmodium does not cure malaria in the recipient.

DAVIDSON, Newark, N. J.

OCULAR MANIFESTATIONS OF LESIONS OF THE FIFTH CRANIAL NERVE. C. M. HINDS HOWELL, *Brit. M. J.* 2:786 (Oct. 29) 1932.

Howell states that he has never seen a "spontaneous corneal ulcer" develop from a supranuclear or intramedullary lesion of the fifth nerve. Acute damage, as by operation, injury or the injection of alcohol into a ganglion, is more likely to produce corneal ulcer than a slower destructive process, such as pressure from tumors. Of sixty cases reported of complete anesthesia of the first division produced by the injection of alcohol, corneal ulcer developed in sixteen. The period of greatest danger seems to be in the first fortnight following the injection. After a month the risk is small. This suggests the possibility of irritation of fibers. The author has never seen involvement of the deeper structures of the eye following injury of the ganglion by alcohol. Roentgen treatment of malignancy will produce severe conjunctival injection if the ganglion has been destroyed either by pressure or by the injection of alcohol. Stitching the lids together is not recommended as a routine in lesions of the fifth nerve unless signs of a developing ulcer appear. Trauma alone does not seem to be the cause of the ulcer in desensitized cases, nor does the author believe that the existence of a trophic nerve influence is tenable. Ulcers in tabs and bedsores in acute myelitis prove that interference with the sensory supply of a part renders the tissues peculiarly susceptible to degenerative or destructive processes.

FERGUSON, Niagara Falls, N. Y.

THE HANDICAP OF CLEFT-PALATE SPEECH. DOROTHY M. WOLDSTAD, *Ment. Hyg.* **16**:281 (April) 1932.

An unrelieved cleft palate takes a human being out of contact with his own world. Filled with a sense of his inability to meet the social situation, he has feelings of inferiority and insecurity. This is an unnecessary tragedy; surgical skill is fully equal to the task of correcting the deformity, and pedagogy is entirely able to retrain the patient. The intelligence of children with cleft palate is within the normal range of intelligence quotient, and offers no obstacle to speech training. The author suggests that every obstetrician should examine the mouth of each child he delivers; that babies who present this defect should be referred to the plastic surgeon within a month after birth. Correction at this early stage is surgically more simple than a later operation, and it has the additional advantage of saving the child from the emotional hazard of realizing that he has abnormal speech. Speech training must supplement surgical correction in older children. One of the major aims of this is to teach the child to project the air stream out of the mouth instead of through the nose; he should be taught resonance and tone quality. An effort should be made to qualify him in some other field, athletics or music, for example, so that he may have reason to feel superior as a balance to any feeling of inadequacy his defective speech may produce.

DAVIDSON, Newark, N. J.

THE PRESENCE OF EFFERENT FIBRES IN POSTERIOR SPINAL ROOTS. SIDNEY KAHN and DONAL SHEEHAN, *Brain* **56**:265 (Sept.) 1933.

A concise but pertinent review of the literature is presented, showing that the question of whether fine axons in the proximal stumps of severed posterior roots can be considered true efferent fibers is still undecided. Laminectomy was performed in the lower and upper thoracic region of seven cats, two roots being divided extradurally. In most of the operations the spinal ganglion was completely extirpated, the anterior and posterior roots being cut through completely immediately centrad to the ganglion. In three cats only the posterior root fibers were cut, and the approach was intradural. Intact fibers were demonstrated by the Bielschowsky and Weigert methods in the central ends of the severed posterior roots. These were considered as normal, mature fibers and could not be looked on as regenerated or degenerating. In view of the histologic difficulties involved, the origin of the efferent posterior root fibers is not postulated. The observations are presented in support of the existence of efferent fibers in the posterior roots examined.

MICHAELS, Boston.

THE RESTING HEAT PRODUCTION OF NERVE. MARY BERESINA, *J. Physiol.* **76**:170 (Oct. 4) 1932.

The rate of resting heat production of frog's nerve at 20 C. was studied in oxygen and during lack of oxygen. In oxygen, Beresina found it to be 176 gram-centimeters or  $4.14 \times 10^{-3}$  calories per gram of nerve per minute. During asphyxiation the resting heat slowly diminished, falling in from three to three and one-half hours to 20 or 25 per cent of its initial value. When oxygen is readmitted, extra heat is produced which is (after from three to four hours of anaerobiosis) between 15 and 20 per cent of the heat missed during the want of oxygen. The resting heat rate in oxygen corresponds to the consumption of oxygen measured by other observers, and the minimum resting heat rate in nitrogen, to the formation of lactic acid observed by Gerard and Meyerbrof. The smallness of the recovery heat after asphyxia agrees with Fenn's observations of the smallness of the recovery oxygen under the same conditions.

ALPERS, Philadelphia.

BRAIN TUMORS: A REPORT OF THE TYPES SEEN IN GENERAL PRACTICE.  
ROBERT ZOLLINGER and ELLIOTT C. CUTLER, *Am. J. M. Sc.* **184**:149 (Aug.) 1932.

The procedure for the study of tumors of the brain is discussed with the various aids in diagnosis. Meningiomas make up 12 per cent of tumors of the brain, and in 50 per cent of the cases in a large series they were revealed by roentgenograms. About 50 per cent of tumors of the brain are gliomas. In the Lakeside Hospital about 43 per cent were astrocytomas, nearly 30 per cent, spongioblastomas and 20 per cent, medulloblastomas. Pituitary adenomas compose about 70 per cent of the tumors in the region of the sella, and 20 per cent are tumors of the craniopharyngeal pouch. The perineurial fibroblastomas or acoustic neuromas compose 6 per cent of all the tumors of the brain. It is believed that meningiomas, certain acoustic neuromas and astrocytomas are amenable to surgical intervention. The histopathologic features of these tumors are described briefly.

MICHAELS, Boston.

A CASE OF VON RECKLINGHAUSEN'S DISEASE WITH FIVE DIFFERENT FORMS OF TUMOR. O. FOERSTER and O. GAGEL, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **138**:339 (Feb.) 1932.

In this case of Recklinghausen's disease, Foerster and Gagel found five different types of tumor in the nervous system. These were as follows: 1. Neurinomas of the entire cutaneous area, of both acoustic nerves and of the left oculomotor nerve. Bilateral acoustic neurinomas are rare enough, but the combination with a tumor of an oculomotor nerve is exceedingly rare. There was also a neurinoma of the first cervical root. 2. A so-called central neurinoma in the medulla. Such tumors are rare, and this type of tumor in the medulla is unknown in the experience of the authors. 3. Scattered through the entire brain are groups of glia elements of varied form. These have been described several times in Recklinghausen's disease. 4. Angiomatous neoplasms scattered through the brain. These were about the size of a pea and were formed of tangles of vessels and connective tissue. 5. Meningiomas scattered over the cerebral hemispheres.

ALPERS, Philadelphia.

ON THE PERMEABILITY OF NERVE SHEATHS. ELBERT C. COLE, *J. Comp. Neurol.* **55**:453 (Aug.) 1932.

An account is given of the behavior of medullated nerves in the walls of the digestive tube of an amphibian (*Necturus*) during prolonged intravital staining with methylene blue. Experimental evidence shows that methylene blue enters living cells and is promptly reduced to its "leuko-base." Although the latter is less soluble than the former, nevertheless it is able to spread from cell to cell and from element to element within the cell. On exposing to the air tissues containing medullated nerves, the medullated sheath is seldom seen stained and never more than faintly. This is held to indicate that it is impermeable to the methylene blue solution. The nodal region, however, is always well stained. This is taken to indicate that the medullary sheath is permeable to oxygen or that there is a rapid migration of oxygen along the axis-cylinder itself and that the node is a point of relatively high permeability.

ADDISON, Philadelphia.

TREATMENT OF CHOREA BY BATHS. W. S. C. COPEMAN, *Brit. M. J.* **2**:1054 (Dec. 10) 1932.

Forty-four cases of chorea of long standing were referred from general hospitals, and the patients were treated without drugs by means of somewhat prolonged immersion in baths at neutral temperature, followed by light massage of the skin. A small control series was treated on orthodox lines. It was found that the same



results were ultimately achieved in both groups. In the case of patients treated by baths, recovery was slower, but the ultimate incidence of relapses proved to be lower in this group than in the other. Copeman believes that probably a combination of the two methods of treatment would be most effective. It is interesting to note that, during the first four or five days, slight cyanosis, shivering or looseness of the bowels was observed after the bath in a few cases. The cyanosis occurred chiefly in the cardiac cases. The sedative effect of this treatment was generally manifest after about a week.

FERGUSON, Niagara Falls, N. Y.

REACTION OF THE CENTRAL NERVOUS SYSTEM TO A RETURN FROM CRITICAL LOW PRESSURE. G. SCHUBERT, *Arch. f. d. ges. Physiol.* **231**:1, 1932.

Rats and rabbits were first exposed to such a low atmospheric pressure (150 mm. of mercury) that central paralysis resulted; then the normal atmospheric pressure was quickly reestablished. The quick restoration of pressure produced an increased reflex excitability and an outbreak of tonic-clonic convulsions, which are explained by the quickly reestablished oxygen supply of the central nervous system. A sudden return from critical low pressure to normal pressure produces in man also an increase in the excitability of the central nervous system, particularly of the optic centers; the sensibility to light is increased, and photisms appear.

SPIEGEL, Philadelphia.

THE VASCULAR SUPPLY OF THE ARCHICORTEX. IV. INBRED ALBINO RATS. E. HORNE CRAIGIE, *J. Comp. Neurol.* **55**:443 (Aug.) 1932.

The capillary supply in the archipallium has been measured in nine albino rats, belonging to the sixty-fifth and sixty-third generations of Dr. Helen Dean King's inbred strain, produced by the invariable mating of brother and sister of the same litter. Injections were made into the brains which were then prepared and studied by the method employed by Craigie in his previous studies on this subject. He states that the diameters of the capillaries do not differ significantly from those in ordinary albino rats, but that the lengths of the capillaries are less. The lengths of capillaries in other parts of the brain, however, do not differ significantly from those in the wild Norway rats.

ADDISON, Philadelphia.

THE FACTORS INVOLVED IN STIMULATION BY INTERMITTENT LIGHT. WILLIAM L. DOLLEY, JR., *J. Exper. Zool.* **62**:319 (July 5) 1932.

Intermittent light of a certain character is more effective than the same quantity of light delivered continuously. In intermittent light there are five variables, namely, length of flash, length of dark period, luminous intensity, flash frequency and total average illumination. Dolley has previously found that the stimulating efficiency of intermittent light for the fly, *Eristalis tenax*, depends on the length of the dark periods. In the present paper it is shown that the effect of intermittent light on *Eristalis* also depends on the length of the flash, the luminous intensity during each flash and probably also on the total average illumination.

WYMAN, Boston.

THE CELL STATION OF THE VATER-PACINIAN CORPUSCLE IN RETROPERITONEAL TISSUE. AN AFFERENT PERIPHERAL PATHWAY IN THE SYMPATHETIC. DONAL SHEEHAN, *Brain* **55**:493 (Dec.) 1932.

Following section of the splanchnic nerves in cats, the main consistent change in the cells of the posterior root ganglia was that the nucleus was eccentric. On sectioning the posterior roots, the nerve terminals in the Vater-pacinian corpuscles, in which division had been made centrad to the ganglia, were all stained in the usual manner. When the roots were sectioned distal to the ganglia, the majority of

the corpuscles showed no nerve terminals. In conclusion: the cell stations of the Vater-pacinian corpuscles of the mesentery of the cat are located in the posterior root ganglia, from at least the seventh to the twelfth thoracic ganglia.

GLOSSOPHARYNGEAL NEURALGIA. W. S. KEITH, *Brain* **55**:357 (Sept.) 1932.

Seventeen additional cases of glossopharyngeal neuralgia are recorded in tabular form, and three of these are reported in detail. It is suggested that *tic douloureux* should be used as a generic term to include a certain type of neuralgia of the trigeminal and glossopharyngeal nerves. *Tic douloureux* of the glossopharyngeal nerve usually occurs after 40 years of age; it is unilateral, and usually radiation of pain to the ear occurs later. "Trigger" spots and marked tenderness are different degrees of the same condition. The incidence of associated disease is much higher than in trigeminal neuralgia. Intracranial section of the glossopharyngeal nerve, as advocated by Adson, is the only method that relieves the pain permanently.

MICHAELS, Boston.

CYSTIC ASTROCYTOMA OF THE CEREBELLUM; REMOVAL OF THE MURAL TUMOR; RECOVERY. C. VINCENT, F. RAPPOPORT, I. BERTRAND and ZADOC-KAHN, *Rev. neurol.* **1**:66 (Jan.) 1932.

A patient is cited who was operated on by Broca in 1897, with evacuation of the cerebellar cyst and disappearance of the symptoms. For twenty-nine years he continued to practice his profession as a notary and reared several children. In 1926, symptoms recurred, and at necropsy the wound was reopened and a cystic tumor the size of a chestnut was found to be a fibrillary astrocytoma. The authors point to the fact that this type of glioma is essentially benign.

FREEMAN, Washington, D. C.

PSEUDOSCLEROSIS OF STRÜMPPELL-WESTPHAL IN FIVE MEMBERS OF A FAMILY. F. J. CURRAN, *J. Neurol. & Psychopath.* **12**:320 (April) 1932.

In this interesting family group the parents were first cousins. The mother showed a unilateral Kayser-Fleischer corneal ring but no pathologic signs on examination. Five children had the corneal ring, which is considered pathognomonic of the pseudosclerosis of Strümpell-Westphal, and manifested neurologic symptoms and signs to varying degrees. Of the remaining five pregnancies, four terminated in miscarriages or early infantile death, while the youngest child of 11 years did not permit examination, although she did not have the corneal ring.

THREE FATAL CASES OF THE BULBAR TYPE OF POLIOMYELITIS. W. G. SCOTT BROWN, *J. Neurol. & Psychopath.* **12**:309 (April) 1932.

Three typical fatal cases of poliomyelitis of the brain stem are reported. In two, tonsillectomy was performed, one eleven days and the other fifteen days before the onset of symptoms. One of the patients showed a thick blood clot lying over the anterior surface of the medulla and pons, inside the pia mater, which extended down the spinal cord to the dorsal region. The patients showed some involvement of the cervical cord region despite the statement they were "without any spinal involvement." The author believes that poliomyelitis should be simply classified into spinal, bulbar and abortive types.

SERLING, Philadelphia.

## Society Transactions

### NEW YORK NEUROLOGICAL SOCIETY

*Regular Meeting, Dec. 5, 1933*

HENRY ALSOP RILEY, M.D., *President, in the Chair*

#### DIAGNOSIS AND LOCALIZATION OF TUMORS OF THE SPINAL CORD BY MEANS OF MEASUREMENTS OF THE VERTEBRAL COLUMN MADE ON ROENTGEN FILMS, AND THE CORRELATION OF CLINICAL AND ROENTGEN OBSERVATIONS. DR. CHARLES A. ELSBERG and DR. CORNELIUS G. DYKE.

In an effort to recognize roentgenographically finer changes in the vertebral column in cases of tumors of the spinal cord, a series of measurements of the size of the vertebral canal and a special study of the pedicles were made. As a preliminary, the roentgen films of one hundred normal spines were studied. The following conclusions were reached: The inner borders of the pedicles are convex, but pedicles with flat inner borders occurred in 59 per cent of the films of all parts of the vertebral column, and pedicles with concave inner borders occurred in 20 per cent of the films taken below the level of the seventh thoracic vertebra.

The measurements of the distance between the inner borders of the pedicles showed that the distance is greater in the cervical and lumbar regions than in the thoracic region. From the second to the fifth cervical vertebra, the interpedicular spaces increased in size from vertebra to vertebra, while from the fifth cervical to the second thoracic vertebra the space between the inner borders of each pair of pedicles became progressively smaller. It was not unusual, however, for the interpedicular spaces of several vertebrae to be of the same size. From the second to the fifth thoracic vertebra the spaces became gradually smaller. From the fifth to and including the ninth thoracic vertebra the size of the spaces was unchanged. From the tenth thoracic to the fifth lumbar vertebra the spaces become progressively larger, although, just as in the cervical region, it was not unusual for the interpedicular spaces of several vertebrae to be of the same dimension.

Exact figures were given regarding the usual and the extreme size of the interpedicular spaces at the different vertebral levels.

The studies of the shape of the vertebral pedicles and measurements of the size of the vertebral canal showed that it was possible in a number of instances to make the diagnosis of tumor of the spinal cord and to determine the location and the approximate size of the neoplasm from the roentgen films. It was often possible to confirm clinical signs and to determine exactly where the operation for the removal of a growth should be performed.

These studies led to the following conclusions: On anteroposterior roentgen films of the normal spine, the inner borders of the pedicles are usually convex, but pedicles with flat inner borders are frequently seen in all parts of the vertebral column; pedicles with concave inner borders sometimes occur below the level of the seventh thoracic vertebra.

Accurate measurements of the interpedicular spaces can be made from the fifth cervical to the fifth lumbar vertebra. The measurements give reliable information as to the comparative size of the canal at the different vertebral levels.

In cases of tumor of the spinal cord there is often an increase in the size of the vertebral canal at the level of the growth. This can be recognized by measurements of the spaces between the pedicles. Enlargement of the canal was found in 43 per cent of sixty-seven cases and was especially frequent when the tumor

was between the tenth thoracic and the fifth lumbar vertebra (fourteen of twenty cases, or 70 per cent).

In cases of extradural tumor an increase in the size of the canal was found in 24 per cent of growths in the cervical and upper thoracic vertebrae, in 12 per cent of growths between the fourth and the ninth thoracic vertebra and in 60 per cent of growths below the ninth thoracic vertebra.

Of the cases of extradural tumor enlargement of the vertebral canal occurred in fourteen of nineteen, or 74 per cent. In nine of these, other changes in the bone were visible in the roentgen films which made diagnosis possible; but in five, the location of the lesion could be discovered only by measurement of the vertebral interpedicular spaces. In the midthoracic region a pathologic increase in the size of the vertebral canal was much more frequent with extradural than with intradural expanding lesions.

At the level of the tumor the inner borders of the pedicles of the vertebrae were often flat and sometimes concave, but this was of diagnostic significance only when associated with a measurable increase above the normal in the size of the interpedicular spaces.

The measurements of the transverse size of the vertebral canal on antero-posterior roentgen films and the appearance of the inner borders of the pedicles were, therefore, of considerable value in the diagnosis and localization of intradural and extradural tumors of the spinal cord. Excluding recent or old fractures of the spine, the enlargement of the vertebral canal described in this paper was found exclusively in cases of expanding lesions within the vertebral canal, and the increase in size was always in the region of the neoplasm.

The roentgen picture must always be correlated with the clinical picture. If the clinical signs point unquestionably to a lesion at a certain level and the roentgen picture shows an enlargement of the interpedicular space at a much lower level, the conclusion must be drawn that the disease from which the patient is suffering is one that affects an extensive area or several parts of the spinal cord. In the absence of other evidence of multiple metastatic lesions or of congenital anomalies of the vertebrae, one sees such a lack of correspondence between the level of the lesion as demonstrated clinically and the interpedicular enlargement in cases of varicosities of the spinal blood vessels.

A much larger experience is necessary before the statement can be made without reservation that enlargement of the interpedicular spaces never occurs with lesions other than expanding ones. Future studies will have to show whether there are exceptions.

In all of the cases on which this report is based the conclusions were drawn from the results of the measurements of the interpedicular spaces and the appearance of the inner borders of the pedicles. In many of the cases the roentgen diagnosis was made without any knowledge of the clinical history, the neurologic signs or the disease suspected by the clinician. Enlargement of the interpedicular spaces was found in several cases in which manometric tests failed to demonstrate a marked spinal subarachnoid block.

Furthermore, from the number of vertebrae involved it was possible to draw conclusions regarding the approximate size of the neoplasm. Small growths produced an enlargement of the interpedicular spaces of one or two vertebrae, while an increase in size of the interpedicular spaces of three or more vertebrae signified that the growth was large. In the thoracic region this indicated that the lesion was an extradural or intradural cyst or, more rarely, a lipoma or a large venous angioma, while in the lumbar region it was either an extradural growth or a giant tumor of the cauda equina.

In correlation with clinical signs and the results of examination of the spinal fluid, it was often possible to determine whether the growth was extradural or intradural and to suspect its pathologic nature. Enlargement of the interpedicular spaces, recognizable only by measurements of the distance between the inner borders of the pedicles, occurred much more often in the perineurial fibroblastomas (neurofibromas) than in the meningiomas.

The measurements of the interpedicular spaces and the appearance of the inner borders of the pedicles were therefore found to be valuable aids in the diagnosis and localization of tumors of the spinal cord. Pathologic enlargement of the vertebral canal of from 2 to 4 mm. can be recognized only by actual measurements on anteroposterior roentgen films. The measurements can be made quickly, easily and accurately.

## DISCUSSION

DR. BERNARD SACHS: This is a splendid contribution. It presents a new method of localizing tumors of the spinal cord by means of roentgen films. Most neurologists who have had a fair amount of experience with tumor of the spinal cord have found that roentgen examination has been of little assistance. I do not see why the authors do not retain the word "interpedunculate." I find no greater difficulty in calling the space interpedunculate than interpedicular.

A point which was of great interest to me was the importance that was attached to measurement of the "interpedunculate" line. The only questions I wish to ask are whether the clinical signs and symptoms enabled the physician to make the correct focal diagnosis, whether in a large number of cases the diagnosis was sufficiently exact for purposes of operation and whether this was based more on the measurement of the "interpedunculate" spaces than on any other factor.

DR. L. T. LE WALD: Every two or three years some new subject pertaining to roentgenology arises; one is apt to compare it with the advent of the Coolidge tube or the Bucky diaphragm and believe that a new improvement in roentgen technic has been attained which constitutes a great advance. I do not hesitate to state that if one accepts as proved this work of Dr. Elsberg and Dr. Dyke it is a decided step forward in the localization of tumors of the spinal cord, and another milestone in the history of roentgenology has been reached.

I was particularly interested in the last remarks of Dr. Dyke in regard to the difference in distance. I think that it is possible to make these films at a distance of 6 feet (182.88 cm.) so that, just as one measures the heart to within a millimeter, one will be able to have a definite standard that everybody can use, with the assurance that the measurements will be uniform. I have been trying some measurements, taking pictures of heads at a distance of 6 feet, and I find that this distance is satisfactory.

DR. CHARLES ELSBERG: As to the significance of enlargement of the interpedicular (or interpedunculate) spaces for the diagnosis of tumors of the cord: There were a few cases in which the diagnosis of tumor was in doubt. In several the condition was considered to be multiple sclerosis. Two such cases were seen in the roentgen ray room in which the presumptive diagnosis of multiple sclerosis had been made. There were, therefore, a number of instances in which the roentgenograms really made or suggested the diagnosis. Of course, the results of every laboratory method should be correlated with the clinical signs, and the neurologic examination is always of primary importance.

DR. H. G. WOLFF: How many cases are there in the pathologic series?

DR. CHARLES ELSBERG: I think that there are nearly a hundred cases; the original series consisted of eighty-nine cases.

DR. CORNELIUS G. DYKE: In reply to Dr. Le Wald, I suppose that some day every one will use the 6 foot distance. It is not possible to take pictures at this distance with the tube stand at the Neurological Institute of New York. It is 41 inches (104.14 cm.) to the top of the tube stand. If we moved it to a distance of 6 feet it would vary the interpedicular measurement less than a millimeter.

A PHYSIOLOGIC ANALYSIS OF REFLEX GRASPING: I. THE RELATION OF FORCED GRASPING AND THE GRASP REFLEX TO THE RIGHTING REFLEXES. DR. I. BIEBER and DR. J. F. FULTON, the Laboratory of Physiology, Yale University School of Medicine.

On destruction of the premotor area (area 6 of Brodmann) of monkeys the symptom of forced grasping appears, as was first experimentally disclosed by



Richter and Hines (*Am. J. Physiol.* **101**:87, 1932). Forced grasping disappears within a few days but can be made to return on both sides after removal of area 6 of the opposite side (Richter and Hines). The grasp reflex, which is the basis of forced grasping, becomes permanently elicitable in all four extremities of monkeys after bilateral destruction of the motor and premotor areas, i. e., areas 4 and 6 (Fulton, Jacobsen and Kennard: *Brain* **55**:524, 1932). In such bilateral preparations we have found that the intensity of the grasp reflex in any given extremity varies with the animal's position in space. When the animal is lying on its left side, only the right extremities show grasping in marked form; the reflex can be inhibited in these extremities by applying pressure from above, i. e., to the right side of the body. When the animal is erect, i. e., with the spinal column vertical, grasping is present in all four extremities; when the animal lies on its back the extremities become extended (labyrinthine reflex), and the grasp reflex becomes minimal or disappears. One may conclude from this that the grasp reflex and the rhythmic reaching movements with which it is generally associated are the counterpart in primates of the more simple rhythmic movements to be seen in thalamic cats and dogs when attempting to right themselves, and that grasping as such is to be regarded as a part of the righting reflex mechanism peculiar to primates. The grasp reflex is not abolished by anesthetizing the skin of the palm.

## II. A PHYSIOLOGIC ANALYSIS OF FORCED GRASPING AND GROPING IN RELATION TO THE SYNDROME OF THE PREMOTOR AREA. DR. J. F. FULTON, the Laboratory of Physiology, Yale University School of Medicine.

This article appeared in full in the February 1934 issue of the ARCHIVES, page 221.

## THE EFFECT OF EXPERIMENTAL LESIONS OF THE POSTERIOR COLUMNS AND OF THE NUCLEI OF GOLL AND BURDACH IN MONKEYS (MACACUS RHEBUS). DR. A. FERRARO and DR. S. E. BARRERA.

The authors present the results of their investigation on experimental lesions of the posterior columns and of the nuclei of Goll and Burdach in monkeys (*Macacus rhesus*). The results may be divided into clinical and anatomic results.

From the anatomic standpoint, the authors brought out and documented with a series of photographs the results of lesions of the columns of Goll and Burdach together or singly. They showed that following an isolated lesion of the column of Goll, the fibers of the column ended not only in the nucleus of Goll but in a more laterally located nucleus known as the nucleus of Monakow or the external cuneate nucleus. They noted the termination of the fibers of the column of Burdach not only in the nucleus of Burdach but in the nucleus of Monakow. There were numerous fibers of the column of Burdach ending in the nucleus of Monakow; the fibers originated as low as the seventh cervical segment. The fibers of the column of Goll terminating in the nucleus of Monakow were much fewer. The fibers from the column of Burdach which bent toward the nucleus of Monakow were ventrally located; the few fibers of the column of Goll which reached the nucleus of Monakow skirted the outermost dorsal edge of the nuclei of Goll and Burdach.

As a result of lesions of the nuclei of Goll and Burdach, the authors have been able to establish the existence of lamination in the medial lemniscus.

The summary of their anatomic presentation established the fact that the fibers originating in the nucleus of Goll occupied the ventral portion of the interolivary space at the level of the medulla oblongata. At higher levels in the mesencephalon the fibers originating in the nucleus of Goll occupied the most lateral and ventral portion of the triangular area known as the lemniscus medialis. The fibers coming from the nucleus of Burdach were found in the most dorsal portion of the interolivary space; at the level of the mesencephalon they occupied a dorso-medial location in the same triangular area.

These results were based on studies of serial sections; the results with the Weigert method confirmed those obtained with the Marchi method.

The clinical results consisted mainly of serious impairment in the use of the extremities. The manifestations were the same for lesions of the posterior columns and for those of the nuclei.

In summary, it may be said that following lesions of the posterior columns and lesions of the nuclei of Goll and Burdach disturbance resulted attributable to impairment of the sense of position. Because of this marked sensory involvement, the animals were unable to correct some of the most awkward and unusual positions which were passively imposed or accidentally assumed. The defect was unilateral and homolateral with respect to the lesion.

Hypotonia resulted from the same lesions; the deep reflexes were normal or even possibly increased, offering a contrast to the hyporeflexia following lesions of the dorsospinal cerebellar tract or of the corpus restiforme *in toto*.

The gait was of the hopping type, in contrast to the gait following a lesion of the corpus restiforme, in which the animal tends to fall toward the side of the lesion, and in contrast with the gait following lesions of the vestibular system, in which the animal shuffles along keeping his trunk as close to the floor as possible.

There was also a disappearance of the hopping and placing reflexes; finally, there was considerable involvement of the grasping capacity of the limbs, though once the animal succeeded in grasping the object he was able to retain a good grip. The difficulty in grasping seemed to be related to the deficiency of the sense of position previously mentioned.

DISCUSSION ON PAPERS BY DR. BIEBER AND DR. FULTON,  
DR. FULTON, AND DR. FERRARO AND DR. BARRERA

DR. ISRAEL WECHSLER: As a clinical neurologist I am interested in the clinical application of physiologic studies, although one must admit the difficulty of correlating animal experimentation with pathologic processes in man. Several years ago, Dr. Brock and I (ARCH. NEUROL. & PSYCHIAT. 17:13 [Jan.] 1927) worked with the Magnus de Kleijn reflexes; some of our observations corroborate the work of Professor Fulton. It proves perhaps that what we spoke of theoretically is true physiologically. We tried to establish that in paralysis agitans there is a loss of a *Stellreflex*—a postural reflex. The "dissolution of erectness," aptly described by Kraus in paralysis agitans, is really the result of the loss of a righting reflex in man. So is the sign described by Souques. (If a patient with paralysis agitans is seated in a chair which is suddenly tilted backward, he fails to extend the legs at the knee joints. A normal person suddenly and unexpectedly tilted backward tries to regain his erect posture by extending his legs.) We think that this is a sign of loss of a postural reflex. In paralysis agitans, so far as is known, there are no thalamic lesions; there is what may be regarded as a thalamic animal. The festination of paralysis agitans, which precedes the propulsion, is an attempt to start a new posture. The patient finds this difficult to do because he is constantly "set" in another posture. He cannot quickly right himself because of interference with corticostriatal pathways. Why this should occur in patients with paralysis agitans in whom there has been no decortication is not clear.

There is some corroborative evidence supporting Professor Fulton's work in the experiments of Warner and Olmstead. Many years ago they stimulated the distal portions of the sectioned frontopontocerebellar pathways in decerebrate animals and thereby abolished the rigidity. The destruction of the frontopontocerebellar pathways, therefore, is presumed to have caused the rigidity. It is possible that the removal of the premotor area, with consequent rigidity and postural disturbance, may be interpreted in the light of the older experiment.

Professor Fulton's statement that flaccidity occurs in lesions of the pyramidal tract, though startling at first, seems to be true in some human cases. At the Montefiore Hospital, Bieber and Davison are working on the problem of pure

lesions of the pyramidal tract; in a certain number of cases, proved by necropsy, the hemiplegia, far from having been spastic, as might have been expected, was altogether flaccid. That one is dealing here with some postural disturbance seems also true.

Another point of interest is the one made by Walshe, who found that one can intensify or bring out a Babinski toe sign by simultaneously eliciting the tonic neck reflex. Thus, if one turns the head to the right and the occiput to the left one may bring out on the occiput or flexion side the Babinski toe sign which was either absent or very feeble.

The question of groping may possibly be correlated with that of posture. The eyes obviously are utilized in the optic righting reflexes, which are part of the series of reflexes described by Magnus. If the animal is deprived of the optic reflex, it is obvious that it cannot even keep on groping, because it cannot employ that optic righting mechanism.

There is one theoretical aspect of the problem regarding frontal and premotor lesions to which I wish to allude. In cases of tumor, hemorrhages or destruction of the frontal lobe, the patient loses what might be called the capacity for an emotional posture. In order to think one must get set, that is, go over from one intellectual attitude to another. The patient with a defect in or absence of the frontal lobe, as Dr. Brickner showed, is incapable of assuming intellectual postures. If speculation is permissible the patient may be regarded as having lost the highest postural reflex in the conative and intellectual spheres.

DR. CLARENCE O. CHENEY: It is interesting to find from these experiments that apparently the fibers from the columns of Goll and Burdach do not end entirely in their respective nuclei, as has been generally supposed, but that some of the fibers continue into the restiform nucleus and have a more or less direct connection with the cerebellum. What the clinical manifestations shown by the monkey mean we are not prepared to explain at present; further observation and study are needed. As Dr. Ferraro pointed out, it is interesting that destruction of either the column of Goll or the column of Burdach causes involvement of the four extremities in the monkey.

DR. H. G. WOLFF: Was there evidence of impairment of either deep or superficial pain in animals with lesions of the posterior columns? Second, was there, with the passage of time and some restoration of position sense in these animals, a recurrence of the inability when the eyes were covered?

DR. RICHARD H. BRICKNER: How does Professor Fulton interpret the symptoms shown by a woman recently studied in the Neurological Institute in the service of Dr. Riley? She had a striking grasp reflex on the right side. Autopsy revealed a small tumor in the left temporal lobe, surrounding the sylvian fissure only. The rest of the brain was normal. I have the impression that other cases have been referred to in the literature in which a tumor posterior to the frontal lobe produced that reflex.

I wish also to question Dr. Barrera and Dr. Ferraro in regard to the lamination of the medial lemniscus. The sections from the monkey first shown indicated that when the nucleus of Goll alone was injured not only was the degeneration ventrally placed but it was small in amount. This suggests that the nucleus of Burdach could produce only degeneration dorsally. The question arises whether all of the nucleus of Goll was destroyed, or only part of it. Also, have the authors observed other cases in which varying amounts of the nucleus of Goll were destroyed?

DR. L. BEVERLEY CHANEY: In addition to the experimental study of adult animals, I wish to ask Dr. Fulton if he has approached the subject from the phylogenetic and the ontogenetic point of view. Certainly, phylogenetically the tonic-digital reflex is very old, and my impression is that it is found in orders lower than the primates. In the ontogeny of the human infant the tonic digital reflex, the grasping reflex, is present until the emergence of prehension, so that I have come to look on the tonic hand reflex as the forerunner of prehension, which

involves eye-hand coordination, which I consider must involve the cortex. From the study of babies it has been my belief that the grasping reflex is very old, that it arises in older and lower orders of the mammalian phylum and that the cortex inhibits this reflex.

DR. ABRAHAM M. RABINER: I have never been able to demonstrate true reflex grasping in a fully conscious person. I refer to patients with chronic disease of all types. On the other hand, I have demonstrated typical reflex grasping in a patient with acute apoplexy; when he emerged from coma the phenomenon disappeared. It was not present during deep coma, but appeared only as he was coming out of it. Similarly, it is not present under deep ether narcosis, but is demonstrable in a patient coming out of ether narcosis. Patients with so-called autonomic imbalance, in whom no actual organic pathologic change in the brain is suspected, also show reflex grasping when they are in a state of panic. Like Dr. Fulton's animals, these persons furnish other evidences of autonomic imbalance, such as vasomotor disturbance of the extremities. What is Dr. Fulton's opinion about these observations? Does he not regard the element of panic, apprehension or defense as playing a part in the grasping reflex.

DR. LOUIS HAUSMAN: I wish to ask Dr. Ferraro several questions with regard to the experiments that he presented. Most textbooks on anatomy and neuro-anatomy show diagrams (not photographs) of fibers going from the nuclei of Goll and Burdach to the cerebellum, as the dorsal external arcuate fibers. That such a connection exists is not at all certain, and for that reason I was interested to see that in the sections prepared by the Marchi method which Dr. Ferraro presented there were no such fibers; apparently the statement which appears in textbooks is incorrect. On the other hand, the nucleus of Monakow, which was also described by Blumenau, does send fibers to the cerebellum by way of the restiform body. With regard to this nucleus, was Dr. Ferraro able to determine the segmental origin of the fibers which it receives? There is reason to believe that this nucleus bears the same relation to the cervical segments and the cerebellum that the column of Clarke does to lower segments and the spino-cerebellar system.

Has Dr. Fulton come to any conclusion as to the actual cortical outlets for the so-called grasping reflex?

DR. C. BURNS CRAIG: When one begins to attribute purpose to reflexes, one lays the ground for serious difficulty and error. Nevertheless, one is tempted to interpret a grasp reflex as an effort at security. As I understood Professor Fulton, he stated that when his experimental animal is lying on one side the grasp reflex is present in the extremities which are up and not present in the extremities of the side on which the animal lies. I therefore wish to ask him this question: With the animal lying on its right side and having laid hold of an object with the left hand, if the board or platform on which the animal rests is removed, does the grasp reflex develop immediately in the right hand in an attempt to make security doubly sure?

Does Dr. Ferraro consider that his work casts grave doubt on the lamination of the fibers in the columns of Goll and Burdach, namely, that the column of Goll represents in a large measure the fibers from the lumbar region and the column of Burdach those from the cervical region?

DR. JOHN H. SCHARF: Has Dr. Ferraro formulated an opinion as to the reason for the loss of tonus in his animals? Does he account for it by the loss of incoming impulses to the nucleus of Monakow, and therefore a loss of tonus as an afferent cerebellar effect, or does he attribute it to a loss of innervation higher in the cerebrospinal axis, in view of the fact that some of the fibers of the posterior column are destined for the thalamus? I raise this question because I had occasion to study a case of hemorrhage in the thalamus which also involved the pyramidal tract; the patient had hemiplegia with flaccidity.

DR. JOHN F. FULTON: I wish to express admiration for the excellent cinematographic demonstration given by Dr. Ferraro and Dr. Berrera of the deficit arising

from these lesions. It occurred to me that possibly some of the descending motor pathways might be involved. It is conceivable, for example, that if the lesion injured some of the more dorsal descending pathways, the flaccidity would be explained. I believe that pure lesions of the dorsal columns in human beings have not been associated with flaccidity, and I say this merely as a possible suggestion. Were control studies made of the degeneration of the descending pathways?

The part of Dr. Ferraro and Dr. Barrera's paper about which I should like to hear more is the relation of the deficit in cortical lesions of the precentral convolution to the sensory loss following destruction of the posterior columns. A comparison of the two lesions presents a highly interesting problem which has not yet been adequately studied in experimental animals.

Dr. Wechsler mentioned the problem of flaccidity in relation to cortical lesions; we can record only that in chimpanzees lesions restricted to area 4 are always followed, in our experience, by flaccidity. Motor power generally returns to a rather striking degree; when the premotor area is destroyed, motor power is further impaired and spasticity develops.

Dr. Brickner raised the question of lesions of the temporal lobe. I am familiar with the reports of cases of so-called grasping in association with lesions of the temporal lobe. We have not yet considered the temporal lobe in our experimental studies. Richter and Hines, however, reported that lesions elsewhere in the hemisphere, including the temporal lobe, failed to cause grasping in monkeys. Beyond that we have no experimental data which throw light on the clinical case referred to.

Dr. Cheney raised the problem of the ontogenetic significance of the grasping reflex. Our impression has been that the grasping reflex disappears when the projection system from the premotor area has been myelinated. The correlation of time in human beings has not yet been sufficiently studied, but in general the time interval appears to be fairly closely related (Langworthy).

Dr. Rabiner asked a number of difficult questions. The appearance of the grasp reflex in patients not fully conscious is an interesting observation. Monkeys from which the frontal and premotor areas have been removed simultaneously are curiously lethargic and show grasping to a degree and in an intensity not seen in other preparations. They are sluggish and grope to an extraordinary degree; and—if I may be allowed the use of the term "conscious" in this connection—perhaps they are not as fully conscious as other preparations, i. e., they exhibit fewer integrations involving the cortex.

The character of forced grasping which occasionally occurs following hemiplegia is a thing which should be more closely studied. The report of grasping setting in after hemiplegia is what one would expect from anterior lesions of the capsule—lesions affecting the descending projection systems from the premotor area.

With reference to narcosis, we have frequently seen an augmentation of grasping in the early stages of anesthesia. An animal in which grasping has disappeared, if given amytal for a second operation, shows strong grasping within ten minutes. The grasping disappears in thirty minutes as the anesthesia deepens, but it reappears in the stages of recovery from anesthesia. Richter has reported an increase in grasping following the administration of bulbocapnine.

The remark about apprehension in relation to grasping is interesting. Chimpanzees with diminishing grasping invariably show the phenomenon in greater intensity if they become frightened. If one leads an animal by the hand around a room and a noise is heard in the next room, a marked increase in grasping is felt. If an animal is at the top of the cage and some one opens the door, the animal may become caught there by an involuntary grasp until some one releases it. The relation of emotion to this phenomenon has been studied by Dr. Kennard. She has found that fright augments the grasping to a marked degree.

Dr. Hausman raised the question of the outlet of the cortical influence which modifies the grasp; as far as we are able to say at the present time the premotor



area is capable of inhibiting the grasp. The motor area may, through the innervation of the flexion muscles, augment it.

Dr. Craig mentioned the purpose of the grasping reflex. It seems to me that in the thalamic preparation the grasp is a reaction designed to bring the animal into a horizontal position. If in the lateral position, the animal gropes, and the groping continues until it comes into contact with an object; then the grasp develops and the body is slowly turned into a horizontal position.

DR. S. EUGENE BARRERA: In our laboratory we have been investigating intensively the effects of removal of the postcentral convolutions and have compared the effects of lesions of area 4 with those of the postcentral area with the idea of detecting, if possible, any sensory component in the motor picture. Following lesions of the postcentral convolutions, the animal may take a position resembling that of an animal with hemiplegia. It loses spontaneous movements of prehension to a great extent and shows hypotonia with, however, good retention of the deep reflexes. Whereas there usually is great deficiency in spontaneous grasping, there also appears to be some difficulty in spontaneously releasing a small object which may be placed in the hand and around which the fingers may be closed by the observer. Likewise, in cases of bilateral lesions the animal may find difficulty in letting go of the wires of the cage, although at the same time he showed difficulty in grasping them. Whether this has elements of forced grasping in it, such as Professor Fulton has described, is not entirely clear at present.

One interesting case showing progressive tonic grasping, in which there was no lesion of the motor system, may be mentioned. In this animal, a wide cerebellar lesion was first made. Several months later both internal ears were removed, and several months following this a complete cortical section of the dorsal columns was made. After the last operation the animal assumed a posture of chronic flexion and contraction. It apparently could not release any object placed in the hand. None of the lesions alone produced this picture definitely, but the combination of the three operations did. If the animal was hung from the cage by one hand it apparently could not let go, although it could not grasp the cage spontaneously. I do not know what relation this has to forced grasping. It is really, I suppose, a "tonic grasping."

DR. ARMANDO FERRARO: In reply to Dr. Wolff, we have tried to test superficial types of sensation, such as pain and temperature, but have had no constant results in the animals' responses. We have not as yet found a sure way to test superficial sensation in our experimental animals. We have also blindfolded the animals, but the type of reaction obtained following the procedure seems the same, with or without the control of vision; it must be said, however, that when a monkey is already handicapped by one type of lesion it has a tendency to remain still following blindfolding and to avoid movement as much as possible, particularly when the lesion involves the proprioceptive system.

It is true, as Dr. Brickner mentioned, that on one side the lesion may not involve completely the nucleus of Goll, but our reason for presenting this particular set of slides was to compare the limited lesion of one nucleus of Goll with the complete lesion on the other side of both the nucleus of Goll and that of Burdach. We think that even though in this particular specimen the lesion of the nucleus of Goll is not complete, it establishes nevertheless that all the degenerated fibers occupy a definite area in the course of the lemniscus. We have, indeed, other specimens in which either the nucleus of Goll or the nucleus of Burdach has been injured separately, and the final result checks with the conclusion here submitted.

I am not ready to answer Dr. Hausman's question as to the homology of the nucleus of Monakow and the nucleus of the column of Clarke. This may be the case, but in order to be sure what type of fiber (short, medium or long) really ends in the cells of the nucleus of Monakow it will be necessary to wait for the completion of another experimental work which we are carrying on; this consists of section of isolated roots of the cervical and thoracic segments of the spinal

cord. As to the connection of the nuclei of Goll and Burdach with the cerebellum through the anterior external arcuate fibers or through the posterior arcuate fibers, we are not ready to affirm or deny the existence of such direct connections. It is a fact, however, that in some of our most successfully impregnated specimens we have been unable to detect the numerous fibers which various authors have described as establishing direct connections with the nuclei of Goll and Burdach and the corpus restiforme.

I do not think that we have cast any serious doubts on the present conception of lamination in the posterior column of the spinal cord. We think, with Dr. Craig, that such lamination exists anatomically, but that possibly in the higher segment of the cord fibers of the column of Goll occupy a more dorsal and medial position, whereas the more ventral and lateral portion of the posterior column is occupied by the fibers of the column of Burdach. Physiologically, however, there should be an explanation, which we are unable as yet to present, for the fact that following lesions of the columns of Burdach impairment of function is also found in the hindlimbs of the animals. There may be some sort of physiologic correlation involving activities in which the anterior and the posterior limbs perform a certain amount of interdependent function.

As to the loss of tonus noted in our animals following lesions of the posterior columns and of the nuclei of Goll and Burdach, I may say in reply to Dr. Fulton that the finding is constant and that no degeneration of the descending tract has been found in our histologic material. Moreover, this loss of tonus was present not only following lesions of the columns of Goll and Burdach but after removal of the postcentral convolution, in which case in addition to the loss of tonus there were hyperactive knee reflexes, just as is the case in lesions of the nuclei of Goll and Burdach.

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#### NEW YORK ACADEMY OF MEDICINE, SECTION OF NEUROLOGY AND PSYCHIATRY

C. BURNS CRAIG, M.D., *Secretary*

*Regular Meeting, Dec. 12, 1933*

CLARENCE P. OBERNDORF, M.D., *Chairman*

PROBLEMS OF DELINQUENCY IN A CHILDREN'S COURT. DR. HELEN MONTAGUE,  
New York (by invitation).

The accomplishments of psychiatry since its entrance into the field of delinquency are difficult to appraise, because of the changed conditions of present day life as compared with those of the past. These changed conditions have complicated particularly the problem of juvenile delinquency. The most fruitful idea developed by psychiatry in connection with this problem is that delinquency is a symptom, the causes of which must be sought in the child's emotional and intellectual make-up, his early conditioning experiences and the principal factors of his environment.

This point of view of the psychiatrist differs materially from the legalistic attitude. Judges are still interested primarily in the act itself—as to whether the child is guilty and what the method of punishment shall be for that particular act. They use the same old categories of allegations. The staff of the clinic attached to the children's court in New York makes an annual cross-sectional study of the children brought before the judges. According to the staff's diagnosis, the problems presented are emotional instabilities—arising from conduct disorders following epidemic encephalitis or brain trauma, glandular disorders, physical defects which cause the child to be ridiculed, maladjustment in school, rivalry between siblings in the home, unwise and brutal punishment by parents and the effects of slum neighborhoods.

One type of problem that stands out clearly is that of the manual-minded boy who is a misfit both at home and at school. He compensates by acts of delinquency on account of his feelings of inferiority and becomes involved in gang life, often with vicious adults. The schools are at fault in so far as they do not supply sufficient trade classes for these manually-minded boys and girls. Whole schools should be given over to this type of teaching.

Organized recreation is also lacking for these underprivileged children. More and more recreational clubs should seek out areas in the city in which delinquency is prevalent and break up gang life by providing play activities of exciting and adventurous kinds.

It has been shown repeatedly that many serious criminals in state prisons began their careers in the children's court. It is believed that this situation is due not to neglect of juvenile delinquents but rather to the fact that many of these persons are so antisocial that their criminal careers would have been inevitable no matter what remedial measures had been used. Definitely psychotic and feeble-minded persons—particularly those with tendencies toward delinquency—are now segregated in proper institutions. Persons with abnormal personality defects who are known to develop criminal careers should also be segregated in a special type of institution for an indeterminate period for the same reason as are the feeble-minded and the psychotic persons. In the children's court, children of this type, for lack of proper placement, are sent to correctional institutions with no beneficial results; later one finds them appearing in the prison groups.

The staff of the psychiatric clinic attached to the children's court of New York has been able to study only about 800 of the 12,000 children who pass through the court every year, and to keep about 300 under treatment. The children to be studied are chosen by the judges, who are now becoming more interested in the psychiatric approach. In order to clarify the situation with regard to the selection, the court statistics were analyzed. Of the 12,000 children seen in court each year, on an average, 7,500 were delinquent and 4,500 were neglected. Of the delinquent children, 4,500 were discharged at the first hearing with a warning or were given a suspended sentence, so that only 3,000 cases a year were left in the hands of the court. The same results were found with the neglected children. It is evident that the court is being cluttered with cases on which the social agencies should be doing intensive preventive work. If such work were done, thousands of children who now come to the court need never be brought there. If this were accomplished, the clinic attached to the court could, with a suitable increase in personnel, work with all the neglected and the delinquent children requiring treatment.

On Oct. 1, 1933, the family court was amalgamated with the children's court, and a court of domestic relations was established. The idea was that the new court would become a social court in which all difficulties pertaining to family life could be solved, including eventually even bastardy and divorce cases. At present, the family court is mainly concerned with matters of support for a wife, child or poor relative. But where a child is concerned, the law definitely states that the court can regulate the behavior of husbands and wives. The new law also states specifically that each division and part of the court shall be served by a psychiatric bureau for the examination of children and of petitioners and respondents in family court cases. The two courts have been combined in the children's court in the boroughs of Bronx, Queens and Richmond; but in New York and Brooklyn, the children's court is not large enough, and the family court is still in its old building. This prevents the close amalgamation of problems which is considered so necessary. In working with children, the importance of the family constellation is recognized, and it is realized that to adjust the delinquent child one must adjust his family problems. There is no adequate substitute for family life, as even placement in a foster home is never completely permanent.

The court clinic has had only a few cases from the family division, but from repeated visits to these courts one is able to prognosticate the types of problems with which the clinic will have to deal. These are problems of chronically ill, psychotic, alcoholic and feeble-minded persons as well as of inadequate and emotionally disturbed persons who cannot make a normal marital adjustment.

Although over 20,000 cases pass through the family division of the new court of domestic relations each year, many of the litigants become reconciled as soon as they get into court. Moreover, as with the cases in the Children's court, the majority of the petitioners and respondents can be helped by the social agencies. It thus appears that the number of cases in the family division in which psychiatric help is needed is reduced to possibly 3,000 a year.

In the new court of domestic relations one may, therefore, roughly estimate that over 3,000 adults and about 2,500 children annually will need psychiatric care. The adequate psychiatric bureau which the law states should be established in this new court should be instituted as soon as possible if this service is to be rendered to those who most need it.

EVALUATION OF CLASSIFICATION IN PRISONS. DR. JAMES L. MCCARTNEY, Director, Classification Clinic, New York State Department of Correction, Elmira Reformatory, Elmira, N. Y. (by invitation).

The prisons house a relatively small number of antisocial persons, for it has been found that of all complaints filed with the police authorities, only 3.66 per cent were groundless. Arrests were made in 42.04 per cent of the cases, whereas in 54.3 per cent no arrests were made. Of the persons arrested, only 44 per cent were convicted—which means that less than 18.5 per cent of the crimes reported end in a conviction. Criminals are created by law, not by instinct, and society is continuing to create criminals; legislatures at each session continue to create new laws; in fact, the statutes define over 400 misdemeanors and felonies. Although the personal factor always enters into the interpretation of the laws, seldom is the personality of the offender taken into account. For example, in the magistrates' courts of New York, in disposing of cases of intoxication, one magistrate found 97 per cent of the persons tried before him guilty, while another found 79 per cent not guilty. One magistrate discharged 18 per cent of those brought before him on the charge of disorderly conduct, while another dismissed 64 per cent. An offender's chance of avoiding a sentence is affected greatly by the particular judge before whom he happens to appear; one magistrate suspended sentences in 7 per cent, and another in 59 per cent, of his cases.

Seventy-four per cent of the New York institutions are attempting to classify their inmates in one way or another, while the others merely lock up prisoners indiscriminately.

There are 48 full-time psychiatrists working in 13.4 per cent of the institutions, and 35 more psychiatrists working part-time in 13.9 per cent. Thus, 27.3 per cent of correctional institutions in the United States have psychiatric service. These institutions have an annual rate of admission of 48,393 prisoners, or about 41 per cent of the total number of persons admitted to penal institutions. These psychiatrists examined on the average between 2 and 70 prisoners a week, or a general average of 14 new prisoners for each psychiatrist a week. The majority examined from 10 to 25 a week and spent between thirty and sixty minutes on each examination. The shortest time reported by any psychiatrist for a routine examination was from three to five minutes, and the longest routine examination was from ninety to one hundred and twenty minutes. The full-time psychiatrist in every institution fulfilled other duties in addition to the initial examination, and 25 per cent also made a neurologic examination of each prisoner. Fifty per cent frequently made examinations of inmates referred by the administration; 40 per cent made routine reexaminations of the inmates and prepared a report for consideration of parole, while 14 per cent were members of the parole board and 7 per cent were members of the disciplinary board in their respective institutions. Thirty-two per cent of the psychiatrists were required to devote more or less of their time to the routine general medical and surgical work of the institution. One man stated that he spent half of his time in this general work, and 5 others stated that it was necessary for them to spend most of their time performing duties other than psychiatric; 2 others served also as superintendent of the institution.

A study of the training of these men brought out that 21 per cent did not care to reveal their training, or lack of training, while 1 who was listed as a psychiatrist definitely stated that he was not a psychiatrist and never posed as such a specialist. Of the 37 men remaining, 90 per cent had served from one to twenty-one years in federal or state psychopathic hospitals, while 19 per cent had also served as psychiatrists in the army during the World War. In the light of the standards as recently proposed by the committee of the American Psychiatric Association, 51 per cent of these men could undoubtedly fulfil all of the requirements for psychiatrists. The shortest time any of the psychiatrists had been in prison work was one year, and the longest time, thirteen years.

Forty-three per cent of the psychiatrists were not members of any psychiatric association. The rest, or 57 per cent, held membership in the American Psychiatric Association, and 53 per cent held in addition membership in one of the other psychiatric associations.

Thirty-six per cent of the psychiatrists questioned did not think that a psychiatric classification was satisfactory for use in the prisons, and only 32 per cent of the institutions having psychiatric service used such a classification, while 23 per cent reported using some form of psychologic classification. In the institutions in which a psychiatrist was present the classification was determined by the psychiatrist; in 21 per cent of the institutions he was assisted by a committee, composed of three or more of the institutional officials. When considering the institutions using some form of classification, it was found that in 47 per cent the classification was by the committee method; in 5 per cent the classification was delegated to a psychologist, and in 10 per cent the classification was determined by the superintendent or warden.

Only 3 psychiatrists, or about 7 per cent of the total number working in prisons, unqualifiedly stated that their recommendations were fully carried out by the administrative officials. Eighteen per cent stated that their recommendations were followed out as far as the institutional facilities would permit, while 24 per cent more stated that they received close cooperation from the administration. The rest, or 46 per cent, frankly admitted that their recommendations were given only passing consideration by the administration. In 13 institutions, the psychiatrist's opinion was seldom taken except when dealing with feeble-minded or psychotic prisoners, and even then recommendations were followed with extreme hesitancy.

It is astonishing how slowly rational methods in the study and treatment of prisoners have been adopted. Only sporadically and often for limited periods have attempts been made to apply extensively any methods of classification. No institution in this country has yet thoroughly tried out the psychiatric method of procedure, although in a few prisons efforts are being made to follow out the case work procedure.

PSYCHIATRIC TREATMENT OF THE OFFENDER FROM AN ADMINISTRATIVE POINT OF VIEW. DR. V. C. BRANHAM, Deputy Commissioner of Correction, State of New York.

Is the criminal a man apart? Is there something in the mental or physical make-up of the person who breaks the laws of the community that makes him basically different from the rest of his fellow beings? This is a question of serious import to psychiatrists, psychologists and all others who deal with the offender as an individual. If one can reject the concept that the criminal is of a definite anthropologic or mental type and can accept instead the modern point of view of the offender as a human being like his fellow creatures within the community, there is then a basis for treatment. Problems of adjustment of psychoses, neuroses and other mental conflicts are subject to the same consideration in criminal and in civilian patients. The laity, however, is far from accepting such a point of view. It chooses to define crime as antisocial conduct—an offense against the established laws of the community. The concept, deeply rooted in the minds of the laity regarding crime and punishment, has as its basis the will to power. That is to say, the average nonpsychiatrically trained man considers that



an offender has committed an overt act wilfully and, therefore, is responsible for his misconduct. The so-called McNaghten formula, devised by the legal profession for fixing responsibility in criminal procedures, states that a person to be responsible for any given act must be able to distinguish the difference between right and wrong and to know the nature and quality of the act he has committed. As the matter works itself out, low grade, feeble-minded and insane persons and young children are absolved from responsibility for their acts. All other persons are considered to have the power to restrain themselves from committing any overt acts against the law. Such a concept, of course is at variance with the experience of psychiatric practice. Physicians recognize generally that insanity and diseases of the mind are not necessarily synonymous. Nevertheless, the legal definition of responsibility holds, and prison and reformatory systems, with few exceptions, are based on this theory. Mass custody of the offender is the rule rather than the exception. Somewhere behind the desire on the part of the layman to put away the offender as a man apart from his neighbors lie the motives of personal castigation, self-renunciation and revenge.

A glance at the historical perspective of penology reveals some of the factors back of the widespread feeling that the criminal is a man apart. The modern prisons or reformatories have been the result of centuries of bitter controversy, cruelty and bloodshed. Institutions for the housing of offenders arose out of the sheer necessity for finding some place to which to remove the criminal from the community. In ancient times punishment was swift and certain. The offender was either killed or tortured. In medieval times, quarters for the temporary detention of offenders awaiting disposition were provided, but imprisonment as the result of trial was not the common concept. Trial by ordeal or by combat quickly disposed of the case. For political offenses, persons often of high rank were thrown into dungeons and forgotten, but the royalty and nobility responsible for the atrocities had no organized system of imprisonment. The decline of the feudal lord and the rise of the merchant guilds withdrew emphasis from offenses against property. The judiciary branch of government came into an increasing power, the influence of which has not declined even to the present day. Jails were organized mostly under local authority, where persons were confined as a result of civil process for contempt of court. Hordes of beggars and vagrants, who were mostly former vassals of feudal estates, swarmed over England during those times and brought about a system of detention for the humanitarian purpose of providing compulsory employment with pay, but these later developed into places of lodgment for debtors and petty thieves. Among the first of these workhouses, or houses of correction, as they came to be called, was the famous Bridewell. The wardenship of this prison and its prototypes was a political plum, distributed by the Crown. Its tenure was lifelong and the pay high. Soon the wardenships were openly sold at auction to the highest bidder, who collected in turn from the inmates by extortion. The cruelties of Bridewell, Fleet and Marshalsea became notorious and led to noted prison reforms through the efforts of John Howard and the writings of the novelist, Dickens.

The Prison Act of 1778 provided for the deportation of criminals. Australia had then become available to England, and its immediate population was deemed advisable. It was thought that the removal of offenders to this far distant land would lead to the highly desirable results of populating that vast continent and ridding England permanently of its undesirable criminal element. Convict ships and the penal colonies of Australia are matters of history. Canada and Georgia provided similar means for the disposition of offenders in the feverish days of the early occupation of the western continent. This excision of the cancerous growth from the body politic afforded immediate relief, but as a result no further development in the scientific care of the criminal took place for the next fifty years.

Curiously, modern methods of housing the criminal arise from religious sources. Institutions for monastic redemption were erected sporadically in early medieval times, the most effectual of which were the Prison for Women at Amsterdam and the Saint Michel at Rome for young offenders. These institutions were many

years ahead of their time and ultimately failed of their purpose through lack of well sustained public opinion. Monasticism with its solitary confinement and opportunity for meditation on the results of sin provided, in the opinion of high dignitaries of the church, the infallible solution to the reformation of the criminal.

Coincident with the idea of placement of offenders in cells for solitude and meditation over their sins came the development of the so-called panopticon, devised by Jeremy Bentham to bring about a maximum security with a minimum supervising staff. The plan of a central observation point so that the interior of all cells could be readily seen has occasionally been revived in this country, notably in the new cell system at the Joliet Prison. Bentham's theory for the rehabilitation of the offender was to educate and to classify the prisoner and to provide for him after discharge, but its main purpose was to prevent crime by discovering and removing its causes—a credo that holds good for the best forms of penal management today. In America, the strict confinement in solitary cells both day and night at the Eastern Penitentiary at Philadelphia was modified at Auburn Prison in New York by permitting the inmates to be released from their cells during the day for work. Thus, in this country, the great rival systems of the Eastern Penitentiary and Auburn laid the foundations for prison construction on a large scale. The Auburn system, established in 1816, enforced silence on the inmates, although they were permitted to congregate. This procedure was in contrast with the Pennsylvania system of solitary confinement. In 1877, at Elmira, N. Y., the first reformatory for young offenders guilty of the lesser felonies came into being. The reformatory system introduced the idea of teaching trades to young offenders so that they could go back into the community with a means of effecting a livelihood. A system of grading with the opportunity for making time off for good behavior was the forerunner of the modern concept of classification of inmates.

Lengthy as this sortie into penologic history has been, it serves the twofold purpose of providing a background for the other papers and of calling attention to the deeply seated traditions operating to block new methods of rehabilitation of the offender. The first differentiation into specialized institutions for the care of selected types of offenders was that of the reformatory at Elmira, opened in 1876. It was brought about by the prison reform group in the interest of the young offender. The second and third stages of differentiation of institutional types were the result of the recognition by the legal profession of certain mental states leading to irresponsibility in definite groups of offenders. "In 1843, one McNaghten, under the delusion of being persecuted by Sir Robert Peel, killed his Secretary. Insanity was plead on the ground that the delusion deprived McNaghten of any control over acts connected with the delusion and the prisoner was found Not Guilty on the ground of insanity." This decision paved the way for special segregation and treatment of the criminal insane. In 1923, New York was the first state to provide separate institutional facilities for the care of the feebleminded offender. The Institution for Mental Defectives at Napanoch has become the model of several similar types of institutions throughout the country.

A fourth institutional differentiation, much to be desired, is that for the psychopathic delinquent. The abnormal conditions imposed on the convict by prison life tend to place an unusual stress on the psychopathic prisoner. As an individual within the community, he has devised more or less elaborate release mechanisms from the pain of mental conflict. Criminals as a class tend to overcompensate. The egotistic, boastful attitudes of this group are well known. Means for substitution and transference are dire necessities for them to secure a satisfactory method of living. If these methods of resolving their conflicts are denied them by a highly repressed environment, such as prison life, mental disturbances occur. This is especially true of the type of psychopathic criminal whose resolution of mental conflict is brought about by the mechanism of projection. Not only should the psychopathic prisoner be removed to a separate institution from the general prison population, but here also belong the large class of persons suffering from addiction to drugs and from alcoholism and vagrant misdemeanants who compose

the recidivistic groups in workhouses and penitentiaries. The group is so large, however, that a careful selective process must be employed.

Psychiatry not only is interested in differentiating the penal institutions into certain types for certain groups of offenders but is laying increasing emphasis on differentiation of groups within each institution. At least five separate units with separate housing, recreational grounds, methods of treatment and skilled personnel should be developed within the average prison. These groups are largely the result of psychiatric study of individual offenders. They may be somewhat arbitrarily classified as colony, recidivistic, segregation, borderline defective and psychopathic observation groups, respectively. They do not include insane or feeble-minded persons, who should be transferred to separate institutions for special care. Classification of this kind is purely an administrative one and makes no pretenses of laying emphasis on clinical diagnosis.

The so-called colony group, or medium security group, as it is often termed, will obtain the maximum amount of freedom with the least restraint of any of the prison inmates. Persons belonging to this group have five years or less to serve and as a rule are of fairly high intelligence and capable of learning easily. They are considered to be the best type for parole. A psychiatrist has an unusual advantage in dealing with these men because their attitude is good and they seem to be willing to make another try at leading a respectable life. Emphasis is thrown on teaching these persons highly specialized trades, such as commercial art, radio construction and management, the theory of the gas engine and advanced automobile mechanics. The opportunities for group activities with this specialized section are usually favorable. The activities include the writing and enacting of plays, debating, the formation of glee clubs and competitive recreational activities. It has been found advisable to construct for this group prisons without walls and fairly comfortable individual rooms with modern toilet facilities. The attitude of the personnel of such an institution is highly friendly and cooperative, and the least amount of officiousness is deemed necessary. Discipline for misbehavior is not a problem, because any inmate not conforming is immediately transferred back to another group in another institution, with the loss of valuable privileges.

The recidivistic group is the least hopeful from a psychiatric point of view, although the incidence of psychopathy is much higher than in other groups. This group is often composed of men in the late twenties with a large number of arrests and convictions on their records. They conform to prison discipline easily because they are "prison-wise" and have found that the easiest way to get along is to obey the prison rules. Many of them are serving a life term and on opportunity become dangerous through inciting disturbance or in revenging gang feuds. Not infrequently, however, an "old timer" suddenly settles down on parole and gives the community no further trouble. He suddenly seems to come of age; but if one were to talk matters over with him neither he nor oneself would be able to give an adequate explanation of the sudden change in mode of action and living. Recidivists are usually housed in what are known as cell blocks. The construction of these tiers of cells affords a maximum amount of security, especially at night, with a minimum force to supervise them. The recidivist accommodates himself readily to life in the cell block.

The segregation group contains the "bad actors." They do not conform to prison discipline and consequently must be removed from the general inmate population. From a psychiatric point of view, several types are frequently encountered in this group. There is the sullen person, who in most instances is psychopathic. Colored inmates, who later may frankly become psychotic, are often encountered in this group. Periodic and emotional outbursts are especially characteristic of the type just mentioned. The dangerous person who shows a strong paranoid background should also be segregated. Such a person is not actually delusional in a fully systematized manner, but is recognized as a killer and usually is avoided by the rest of the inmates. Also assigned to this group temporarily are inmates whose offenses have been rather serious and in whose cases punishment for a brief period seems to be in order. Many types worthy of

intensive psychiatric study are to be found in the segregation group. The incidence of potential psychosis is higher than in any other group in the population. The process of delusion formation is encountered here more frequently than elsewhere. From an administrative standpoint, the segregation group should be walled off from the rest of the population, with separate housing and feeding facilities and a separate recreational yard. In addition to this, the housing facilities of the cell block type should be further divided into small groups of floors, each floor containing approximately from twelve to fifteen cells. This permits differentiation within the group itself.

The borderline defective group is composed of persons whose intelligence quotients range from 70 to 85. They are not of sufficiently low grade intelligence to be classified as feeble-minded and therefore should not be transferred to another institution, but they are sufficiently retarded so as to be at a disadvantage with the normal inmates. The result is that the mildly retarded borderline convict, especially if he tends to be emotional, is at a disadvantage and is easily imposed on by his better endowed fellow inmates. He does not have the intelligence and flexibility of mind to meet the situation properly, and therefore the result is often outbursts of temper, fighting or submission to the domination of others. Such a situation creates difficulties administratively, and it is better therefore to segregate this type of person for special treatment. Housing of the dormitory type is often suitable for the mentally retarded delinquents. Special emphasis is placed on education in this group owing to the large number of illiterates and those with lack of an education that could be termed that of average, common school standards. This group lends itself more to the psychiatric social type of approach than to the analytic or strictly interpretative method. The daily life of these persons can be more highly "routinized" and placed on stricter schedules than is possible with the more intelligent groups, owing to the fact that they accept monotony with relatively less resentment. Military drill with this type is often effective and leads to a discipline not obtainable in any other way.

The psychopathic observation group offers perhaps the best opportunity of all for psychiatric approach. There is no fundamental difference between the psychopathic person within prison walls and the psychopathic person who has never broken the mandates of the community. The psychoanalytic method of approach is often valuable in highly selected cases. In others considerable medical attention is required, and the patient frequently suffers from a marked sense of inferiority based on physical defects. Every effort should be made to secure skilled hospital service and consultation of experts for all necessary operative work to cure deformities, to adjust ocular troubles, to bring the general physical tone and weight up to normal and to bring back to these inadequate people the self-assurance that is necessary to permit free mingling with the normal members of the prison population. A recently developed service in this connection is the establishment of a ward for the adjustment of mild temporary mental conflicts. Convicts who become mildly upset over happenings at home or over pressure brought to bear by other members of the inmate population can get a grip on themselves by spending a few days in the quiet of the hospital. These persons are not to be confused with the potentially psychotic type. They tend to be the emotionally unstable and the schizoid type of psychopathic patients. It must be recalled that the environment of a prison does not afford the methods of escape from distressful situations that are to be found on the outside. Consequently, persons who are placed under some temporary, unusual stress should be given the opportunity for quiet and removal from the daily obligations imposed on them. At first thought this would seem to be a refinement of the handling of criminals. Study of such a procedure, however, reveals without a doubt that a few days of careful nursing in a quiet ward eases the man over the stress and prevents him from becoming a person to be committed to a state hospital. It is not within the province of this paper to discuss the motivations of crime nor the mental life of the average offender who has not been included in any of the preceding groups. Such a discussion must be left to the clinician.

The grouping of inmates noted offers distinct advantages for psychiatric treatment of the individual criminal. Administratively speaking, another grouping may be made, namely, the use of institutional facilities. These may be roughly classified as the psychiatric clinic, the hospital, the school, trade, recreational activities and religious facilities. As they are admitted to receiving institutions, the inmates should be studied during a detention period of thirty days and classified before being turned into the general population. During this time complete study from a psychiatric, psychologic, medical and occupational point of view is done; the staff of the institution has the opportunity to discuss the case, and the man is then assigned to the proper trade or prison industry. Procedures of this kind do not offer any intensive psychiatric study but are largely rapid-fire methods for adequate placement within the institution. Certain new inmates on being admitted, however, are earmarked for future study. Particular persons under this classification are men who may be termed intensively psychopathic and in need of continual psychiatric treatment, the inadequate, immature types needing the guidance of an older person, the physically under par and those whose assignment to industries or trades leaves sufficient doubt as to their progress to require checking up from time to time in the first year or two. The clinic is of great assistance to the educational unit in providing abstracts of histories of cases, and especially in pointing out defects in personality development that could be used as a basis for assigning projects in school work. In such a manner the schools, the recreational grounds and the shops become adjuncts to the clinic for the psychiatric adjustment of selected offenders. A close tie-up between the hospital and the clinic is strongly advisable. Many inmates are referred from sick call to the clinic for further psychiatric treatment because of the absence of physical causes to account for symptoms. In return, inmates are referred from the psychiatric clinic to the hospital for further study and adjustment, particularly along the lines of treatment for malnutrition, syphilis and endocrine disorders, adjustments of deformities and disfigurements of all kinds that may be the basis of feelings of inferiority and dental work. Joint meetings between the staffs of the clinics and the medical services for the consideration of patients with mixed symptoms are highly desirable and should be a routine procedure.

The differentiation of types of correctional institutions and the differentiation of units within the institutions should be supplemented by the organization of certain forces within the community. Much has been done through probation and parole services to investigate the environment of offenders placed on probation and of parolees, prior to parole, to secure them jobs and to see that nothing occurs to prevent them from making a successful readjustment to the community. There is an increasing tendency to secure well qualified case workers as parole agents. Such a procedure brings about a close cooperating arrangement between parole and probation departments and welfare agencies operating under private funds. For example, a parole agent may want to know more about the family of the parolee, or man under suspended sentence, than he is able to ascertain with his limited time and resources. The case is put through the clearing house, and certain agencies are found to have handled either the case or other members of the family in previous years. Valuable data are obtained, and it may be possible to secure certain amount of supervision through agencies already in charge of the family. In many respects, successful parole and probation are the result of an adequate tie-up with facilities already existing in the community. Not the least of these is the psychiatric clinic. Psychopathic persons under treatment by the psychiatrists of the classification clinic within the prison often require on parole the future services of a psychiatrist. The means for employing a private practitioner in psychiatry may be at hand, or the parolee may be required to attend a well organized psychiatric clinic. In either event, the institutional psychiatrist has the proper tie-up with psychiatric clinics on the outside to which the man can be referred. In these clinics service can be given to the man directly or he can be advised where to go in the event that he is in a position to obtain this specialized service. Epileptic patients are particularly in need of follow-up study. Also



persons suffering from alcoholism and drug addiction should receive supervision for a stated period after parole. Psychiatric clinics interested in carrying on the treatment of parolees from correctional institutions should have the proper means of utilizing the services of welfare agencies, parole and probation departments, vocational adjustment bureaus and employment offices. Putting it in another way, the clinic should be prepared to utilize a definite portion of its psychiatric service to act as an intermediary between the clinic and the groups in question. Adequate disposition of the parolee who is in need of psychiatric treatment cannot be obtained unless this procedure is carefully carried out.

The procedure of housing a large number of offenders in custody and for punishment on the mass plan is steadily giving way to a system of specialized institutions for specialized treatment of the criminal insane, of the mentally defective delinquent and of young first offenders of the best type. Further differentiation is being made within the correctional institutions along the lines of segregating groups with special housing facilities, recreation and differing methods of treatment. The facilities of the institution are further differentiated into units which are made especially serviceable for handling the inmates adequately on the group plan. Not the least important of such units is the clinic. Psychiatrists working from the clinic can become most effective in the readjustment of certain psychopathic patients and in utilizing the medical, recreational, educational and industrial units as adjuncts to the study and treatment of large groups of offenders. It is highly necessary that work of this kind be supplemented by the organization of forces within the community to supplement the activities of the institution. Chief among these are parole and probation divisions of the institutions and courts, respectively, welfare organizations, capable of furnishing case materials and a certain amount of supervision in cases of parole, work bureaus and clinics, both psychiatric and medical. There is evidence that an increasing number of psychiatrists are becoming interested in the field of correction. It is a field relatively unexplored and offers great opportunity, especially for the young man who is desirous of making this activity his life's work.

#### DISCUSSION

DR. BERNARD SACHS: I have had an infinitesimal prison experience. I am perhaps one of that fortunate group which one of the speakers said remained outside. However, I have had some experience with the criminal insane, and I think I may claim that I have had considerable experience with the youthful delinquent. For that reason I am in especial sympathy with the facts presented by Dr. Montague. After all, the period of childhood is here, as in all other conditions, the prophylactic period. If anything can be done to prevent the development of crime, preventive measures will have to be resorted to early in life. I have said at various times that I believe that heredity is of relatively less importance than environment. Much is heard about the factor of heredity in crime, whereas I am almost persuaded, though I am still open to conviction, that if one placed a child born of criminal parents in a sound and healthy environment that child would easily overcome the effect of hereditary tendencies, provided it were kept in the proper environmental conditions. In children born of well behaved parents the early training is undoubtedly of the very greatest importance. Much was said by Dr. Montague and the other speakers, or it was intimated by her and stated by the others, that the laws create the criminals. There is apt to be a great misinterpretation of that sentiment. As I see it, the laws have only established certain conventions under which it is proper and agreeable for the majority of people to live. The most normal child is born with criminal tendencies. That is, in the earliest period of its life a child has no realization whatever of the differences between mine and thine. Yet that is the one cardinal thing that has to be impressed on every child, and that can be done only by proper training. Since that law has been created, one cannot possibly allow the original criminal tendencies of the child to persist. I believe that the work that has been done by the children's court, and the whole idea of the children's court, has undoubtedly

been of tremendous help in this matter. I do not know whether the court of domestic relations is going to be better than the other court. I believe that no young person should be stamped as a criminal or as having criminal tendencies until every possible opportunity has been given to correct whatever false start may have been made in life.

While I am in absolute sympathy with what has been done in a prophylactic way with children, and I hope it will be done more successfully than before, I am a little fearful of the effect of much that is being done with regard to the adult criminal. I am not fearful, however, of doing everything possible for the person with criminal tendencies during the adolescent period. I think that is another period of life at which the so-called criminal tendencies are apt to come to the fore, and yet it is a period at which these tendencies can be correlated.

As one of the Thomas W. Salmon Memorial Committee I can say to my fellow members that the help which they gave to Dr. McCartney in his investigation has been fruitful. I am thoroughly in sympathy with the attempt he has made at classification, or rather that he has attempted not to present too minute a classification. I am astonished at only one thing, that he is so thoroughly unhappy apparently that all psychiatrists do not agree. Why should he expect the psychiatrists to agree when it is well known that doctors never agree? If the topic were not so easily subject to disagreement he would have reason perhaps to feel as unhappy as he does. Of course, there is not complete unity among psychiatrists, and there never can be and never will be, but I think that it is just in every instance to attempt to find possible excuses in the mental or physical make-up for the crime or wrong that a person has committed. However, one does not want to grow morbidly sentimental in this matter. Society above all things demands protection against crime, and that seems to me to be the most important consideration. I want to be as humane and as kind as possible to the man who has erred or fallen, but sentimentality must not interfere with the proper treatment of crime. Until now, unless the learned judge who is to follow me can prove the contrary, I do not know of any better deterrent of crime than the fear of penalty; if that is the case and the punishment fits the crime, every one knows and expects it. I want the child protected by all odds, but the person who has committed a crime after the adolescent period knows he has done wrong, has been warned he should not do wrong and knows what the effect of his crime is on the community. That that person should receive some penalty is, I think, a condition one has to accept, much as one might regret it. There has been a tendency on the part of the public to sympathize with the criminal beyond what I think the criminal deserves. I know that it is not easy to lead a virtuous life. The older I grow the more I notice the whole tendency of this age to make one selfish to the extreme. One thinks only of what is good for oneself, or for the persons connected with oneself, and I think that that represents a sad lack of the proper sympathy and proper appreciation of what is right for the majority of one's fellowmen. I believe that psychiatrists and physicians, combined, have a serious and promising duty in this matter of the study of the criminal, but with every desire to help the criminal, and above all to be humane toward him, let them not grow morbidly sentimental.

JUDGE JONAH J. GOLDSTEIN (by invitation): As the various papers were read and discussed, it seemed to me that I would find myself in the same position as did the rabbi whose advice was sought to adjudicate a dispute between a quarreling husband and wife. The wife was the first to see the rabbi, and after telling her side of the story was assured that she was right. Shortly thereafter, the husband appeared and told his story; after listening patiently the rabbi assured him that he was right. The rabbi's wife, who had overheard the conflicting stories of the husband and wife, as well as the advice given, turned to the rabbi and said: "My dear, how can they both be right?" To which the rabbi replied: "You are right, too." And so for a time it seemed that I might be in agreement with all that has been said.

In this tragedy of errors entitled "Crime and How It Can Best Be Treated," and a tragedy it is, I represent the judge who has stood between science and the

problem of crime, too often blocking the road of progress. No one will gainsay the importance of the problem of crime and the criminal; and by crime, I refer not to violations of criminal statutes but only to antisocial behavior. In placing the emphasis on the treatment of the criminal public resentment is aroused. The emphasis should be placed on the protection to society.

My listener and I may differ on what will happen tomorrow. History tells what happened yesterday. History records, and the fact is that the more brutal the punishment the greater the increase in crime. Picking pockets in Merrie England was punished by hanging. The foot of the scaffold was the place where the nimble-fingered gentlemen principally plied their profession. In treating the problem of crime and the criminal, society must make its choice between punishment and treatment. If punishment is the aim, let one be logical and exterminate the inveterate criminal. Putting criminals in jail merely serves to protect society temporarily during incarceration. There are more criminals out of jail than in.

The function of the judge should end with the conviction. It is the judge's task to see that no one is convicted except on legal evidence and in accordance with law. What is to be done after conviction requires more than the knowledge, training and experience of the lawyer sitting as a judge. The judicial gown does not vest its wearer with supernatural powers, nor does it give him greater knowledge than he possessed as a practicing lawyer. The study of bills and notes, corporation law, negligence, wills, trusts, admiralty and kindred subjects does not qualify a lawyer to prescribe the best treatment for antisocial behavior. The law makes provision for probation, parole and physical and psychiatric examinations. The law, however, makes no provision to compel the judge to follow the advice of the various sciences better prepared to map out behavior programs designed to effect rehabilitation of the delinquent and converting social liabilities into social assets.

All thinking people agree that more effective work can be done with the young than with the matured. The legislature, in line with this progressive thought, removed juvenile delinquency from the category of crime and created children's courts for socialized, as distinguished from legalistic, handling of juvenile delinquency. For the better handling of juvenile delinquency on a socialized plane, probation and psychiatric departments were set up as integral parts of the court. In line with the same thought, the problems of domestic relations (such as non-support) were taken out of the hands of criminal law and transferred to a court of domestic relations, to which court was also transferred the work of the children's court—all this in recognition of the fundamental principle that the family could best be treated on a unified basis. If the children are delinquent, the parents should be "inquired into;" if the parents are quarreling, the children should be looked after without waiting for their arraignment as juvenile delinquents. The prescription is no better than the doctor. If a judge in the court of domestic relations had a problem with his own child or his own wife and the problem involved behavior difficulties, the last one he would consult would be a brother lawyer. And yet, under the law, only a lawyer sitting as a judge can prescribe the treatment for juvenile delinquency and family problems.

Dr. Helen Montague has neither the power nor the authority to map out a behavior program for the treatment of the juvenile delinquent. As a psychiatrist, she is subordinate to the lawyer sitting as a judge in her court. No advance will be made in her court in the treatment of behavior problems until the psychiatrist is placed at least on a par with the judge. The "court" as applied to domestic problems, juvenile delinquency and sentence in courts of criminal jurisdiction should give way to clinics in which individual diagnosis will be made and prescriptions (behavior programs) planned. After the diagnosis and prescription of treatment are made, the patient should be watched and the treatment changed as required. The socialized institution cannot be run from a legalistic point of view. The law as such can neither prescribe nor treat juvenile delinquents nor can it plan behavior programs.

When I presided in the family court, a man was arraigned charged with inadequate support as well as beating his wife. The husband explained that the

quarrels arose because he was being fed mainly on stews and hash. He wanted meat. The wife explained that because of the loss of her teeth she was partial to stews and hash. In answer to her complaint that he did not take her out at night, he said: "Look at 'er. I wouldn't take 'er to a dog-fight." Do you suppose that I could solve that problem with "objection sustained" and "objection over-ruled?" I am frank to admit that I never adjusted disagreements in my own home with "objection sustained" and "objection over-ruled!" I consulted with some kind-hearted, level-headed married woman affiliated with the big-sister movement; in fact, I turned over the case to them for check-up. They got the woman a set of teeth and a permanent wave. They taught her how to primp with a bit of powder, lipstick and rouge; they provided her with a dress; they taught her how to be coy. She was an apt pupil, and within a week she phoned to say that everything was all right and that her husband was taking her out at night.

As soon as it is recognized that the problems of human behavior have nothing to do with "objection sustained" and "objection over-ruled," and as soon as the diagnosis and treatment of such behavior problems are left to those who know something about them, more progress will be made. Many psychiatrists make the mistake of promising the millenium. My advice is, promise nothing except honest effort and progressive thinking. Old methods of punishment have accomplished nothing. The sciences as applied to the correction of antisocial behavior will do better than nothing. Scientific treatment should lead the way and supplant thoughtless legalistic punishment. I repeat, the choice is between the old and the new—punishment or treatment. In discarding the old for the new, there is nothing to lose, and everything to gain. The solution lies in more power to the psychiatrist and less power to the courts.

DR. MENAS S. GREGORY: I agree with Dr. Sachs and am delighted with the statement of Judge Goldstein. I hope that what he said regarding the partnership between the courts and the psychiatrists in an advisory capacity to the courts will be given widespread publicity.

The papers by Drs. Branham, McCartney and Montague were full of interesting information and suggestions and reveal the great progress that has been made in the psychiatric handling of criminals in correctional institutions. Twenty years ago this type of work in jails or penitentiaries would have evoked all sorts of opposition.

I believe that all of those present believe with Dr. Sachs that the time to prevent delinquency and criminality is in childhood and during the developmental years. The department of hospitals of the city of New York has a psychiatric clinic in connection with the court of general sessions. During 1933, nearly 60 per cent of convicted criminals who were examined in this clinic were so-called recidivists or habitual criminals. On studying the childhood history of every one of them one finds, whenever information is obtainable, that there was some difficulty in childhood—all were problem children, or "children's court cases." I believe that the foundation for neurotic and psychopathic trends, as well as delinquency, is laid down in childhood and during the adolescent years. I think that the community should be enlightened in this respect and be informed that the time for real preventive work in delinquency is during childhood.

Dr. Branham and Dr. McCartney discussed some of the difficulties encountered in carrying out psychiatric work in correctional institutions. I am sure that time will rectify many of these shortcomings and difficulties. In this connection I wish to speak regarding certain attitudes of psychiatrists toward crime and criminality, which may create prejudice in the public mind concerning the value of psychiatric work. In other words, I wish to "scold" psychiatrists. It is true that as physicians, as Dr. Sachs pointed out, they are primarily interested in the individual man—in his restoration and rehabilitation—but they should always, as good psychiatrists, keep in mind that the attitude of the general public is, as a rule, unfriendly toward the delinquent and the criminal. In their enthusiastic recommendations for the improvement of conditions in prisons and the treatment of the criminals in correctional institutions they must not lose sight of the fact that the

community as a whole does not forget that the criminal is antisocial—an enemy of society. In the discussion of prison reform with laymen one frequently finds that even the most intelligent are laboring under resentment and prejudice toward the problem of prison reform. They seem to be more interested in the criminals' victims, and they particularly seem to point out the criminals' own families, who have suffered injury economically, socially and otherwise. In other words, the sentiment of the people is overwhelmingly against so-called "coddling" and "pampering" of prisoners when their victims are in want and distress.

It should also be stated that there is a strong skepticism on the part of the public, as Dr. Sachs pointed out, with regard to the possibility of reformation and rehabilitation of the adult criminal. I am, of course, speaking not of the accidental criminal but of the real or so-called "psychopathic and habitual criminal."

These facts should carefully be considered while one is advocating changes and reforms in correctional institutions which will entail enormous outlay of public funds.

Another important point is the fact that psychiatrists, in their enthusiasm, are apt to give the impression to the public that psychiatry (perhaps putting it in a somewhat exaggerated manner) is the only panacea to solve the problem of delinquency and criminality. Curiously enough, the public at first responded to this with equal willingness and enthusiasm. However, it is beginning to have some doubt as to the value of psychiatry in the solution of the problems of delinquency. In order to make my meaning clearer, I shall quote from a recent address which was made to a gathering of distinguished psychiatrists regarding this very subject:

"Are we not as psychiatrists, putting forth much effort without adequate return, in the application of psychiatry to social problems, for the reason that the public is not sufficiently prepared to appreciate the significance of efforts of this kind?"

"It may be conceded that with patience and perseverance, the community may become in course of time more receptive to efforts of this sort, but I wish to add a word of caution against the danger of our 'overselling' social psychiatry.

"Psychiatry has justly become very popular among the general public, which through over-enthusiastic propaganda has been given the impression that it is the panacea for all social problems.

"While admittedly it can contribute most effectively to various community problems, there is danger of disappointment and disillusionment, which might react destructively to our own efforts. There are already signs and rumblings of this repercussion. The nature of psychiatric work is so abstract, and the results of its application so slow and intangible, that there is beginning to be aroused skepticism in the minds of the public, as to its value.

"This applies not only to psychiatry, in relation to delinquency, but also to mental hygiene, child guidance, probation, and many other psychiatric social efforts.

"There are already complaints and criticisms on the part of people—teachers, parents and even social workers—as to the vagueness, impracticability, triviality and at times total futility of child guidance efforts.

"Similar observations are also applicable to the subject of delinquency, probation and other psychiatric social problems.

"In other words, I personally feel that there might be a real danger in over-playing and over-selling psychiatry in its social implications, unless we at the same time take adequate measures to bring up the public to the proper psychological level to fully appreciate our efforts. Otherwise, there is danger of retrogression instead of progress."

DEPUTY COMMISSIONER HENRIETTA ADDITON (by invitation): As a police officer I am especially concerned because so many children for whom my associates and I want help in regard to treatment come to our attention. Many of the speakers have mentioned the need for work with children and adolescents. The main objectives of the Police Department's Bureau of Crime Prevention are the keeping out of court, as far as advisable, children who break the law for the first time, cleaning up the areas that are breeding delinquents and building up the constructive forces of the community. In all those things we need the help of the psychiatrist. There are many



children growing up in the sections of the city which produce most of the delinquents who are not delinquent. We need the help of psychiatrists to find out what different combinations of environment and personality make for delinquency. All types come to us. Fathers come about their boys who are beginning to run around with gangsters, and mothers about daughters who they fear are becoming immoral. Neighbors complain about boys breaking windows. Small storekeepers complain of children stealing; they do not want to make a court complaint but do not want the offenders to go completely without supervision. We receive many different types of complaints from principals of schools. Recently, one reported four boys, aged 12, who were forcing smaller boys to pay them 2 cents a week for protection on the playground from older boys. A nice racket! There are boys in some sections of the city who go into grocery stores and ask for sandwiches and apples. They tell the storekeeper, if he asks for payment, that they will break up the store. Others promise storekeepers who give them apples and other things protection against being molested.

Whether we take a case into court depends not so much on the offense as on the individual offender and what can be done for him out of court. I do not think we are sentimental. If it is necessary for the good of the child or of the community we take court action. However, a great many of the children are much better helped before than after court experience. But we must have the aid of trained psychiatrists in handling these behavior problems. I have felt that too frequently our officers perhaps were not understood or did not understand just what was wanted by the psychiatric clinics. The work of the psychiatrist in combination with the court is extremely important, but it does not seem to me to be as important as the work in the field of prevention. An editorial came to my attention some time ago quoting a physician regarding crime and appendicitis. The editor tells of one offender who went straight after an appendectomy was done. Other cases of criminals being changed to normal citizens by surgical measures were cited. The editor goes on to say, "Not until the relationship of health and crime is recognized by laws and by courts will this country be in a position to deal intelligently with crime. The time will come when such officials will be deemed as necessary to the course of justice as defense lawyers or district attorneys, and when criminals may be sentenced not to prison but to the operating table." Appendicitis as a cause of crime is probably as sound as many of the causes assigned. We had a boy, aged 13, accused of stealing, who was referred to the crime prevention bureau by a school principal. He had an operation for appendicitis, and he stopped stealing. We have had a young robber with a thyroid disturbance whose personality has changed under treatment. Isolated cases prove nothing. In order to determine causes, the results must be tested by controlled groups.

I wish to ask a few practical questions of the psychiatrists. The policemen assigned to the crime prevention bureau are intelligent and have peculiar qualifications for helping delinquent boys. They need guidance in handling the children who come to their attention. They do not want diagnosis alone—they want therapy. We should not expect a pill which will cure all behavior problems, but do we not have the right to expect guidance in treatment? Changes in environment have been found to be most effective in changing delinquent behavior. Should the psychiatrist be expected to recommend the type of environment most desirable? Can we not expect guidance about school work and about changes in classes or in curriculum? Why are certain children truant? Can we not expect advice about work and about recreation? Can the psychiatrists advise us in individual cases in which group work should be prescribed? I do not know how much they are prepared to answer, but that is what we need and what our officers are looking for. It seems sometimes that psychiatric clinics are too interested in the teaching side. If clinics could be established in which the legal and social agencies worked with the physician and the psychiatrist on the problem of handling delinquents when they first come to the police before they have been in court, a real demonstration could be made which would be of value not only to the child with behavior problems but as teaching centers for physicians entering this field.

DR. BERNARD GLUECK: It is puzzling to me why the psychiatrists are administering to themselves this self-castigation. What is the basis of this masochistic trend? If one has listened carefully to Dr. Branham's paper, to his historical sketch of criminology up to the middle of the nineteenth century, and then has compared with it what he had to say in describing the subsequent developments in the treatment of the prisoner, even en masse, one will have to acknowledge that of all the forces that have been responsible for the radical change in man's dealing with his fellowman who has transgressed the law—the criminal—psychiatry was the central and outstanding force in bringing about this change. There may be a difference of opinion as to the value of this change, but in so far as it reflects progress in attitude, in vision and in hope with respect to the problem of crime, I think that the psychiatrists above every one else, and psychiatric progress in medicine above everything else, are responsible for this change.

Now let me shift to the first paper of the evening, the excellent, uncomplicated and direct story which Dr. Montague told about the manner of dealing with the juvenile delinquents in this community. It is a genetic approach which embraces a study of origins, of all kinds and sorts of origins, which aims to see in the delinquent child the reflection of all possible influences to which a child is subject in a community like this one. In this clinic as well as in other juvenile clinics one sees conscientious, earnest, intelligent, hard-working people who are trying to apply whatever scientific knowledge there is with respect to human conduct to these problems. When one considers how children were dealt with in the days of Charles Dickens, how children are dealt with today in some sections of the country and that it practically took a national calamity to bring about the abolishment of child labor, one cannot fail to recognize progress in the efforts that are reflected in dealing with the juvenile offender. Here again I have no hesitancy in stating that the psychiatrist, the increasing opportunity of applying psychiatry to social problems, has been in the center of this progress. Psychiatrists have nothing of which to be ashamed. I do not care what the average warden's opinion is about psychiatry. I do not expect anything else of the average prison official. The psychiatrist is a threat to the traditional warden. The entrance of psychiatry into the prison forces a kind of transformation of a traditionally foul institution that destroyed human beings instead of aiding them to a personal reconstruction. The entrance of psychiatry forces a different orientation on the part of people who traditionally looked on the prison as a place for the exploitation of the helpless. My own interest in prison work and in the study of criminals came as a curious realization that the prison, as an institution which the citizens support, frequently constituted a destructive experience to the persons who were sent there presumably in order to be discharged as better men. As far back as twenty years ago, at the Government Hospital for the Insane in Washington, one repeatedly saw persons with acute mental breakdowns coming from prisons because of the kind of treatment, the kind of housing, the kind of vision and the kind of orientation that they were exposed to. It was in an effort to find out why the prison was a destructive force that I originally became interested in this field. I am proud of psychiatry and of its achievements in the past twenty years. I am proud of the fact that physicians in place of disciplinarians are filling positions of trust and opportunity as far as the prisoner is concerned. I am proud of the things that have been done in the field of prevention. About fifteen years ago I had a class of policemen at Columbia University, and they were a very enthusiastic group of men. No doubt undertakings of this nature have contributed to the change of view that is reflected in the police bureau of crime prevention in this city. I do not think that psychiatry has done such a bad job, but Dr. McCartney gave a few hints why it has not done better when he said that as a result of his study he has come to the conclusion that there is not a penal or correctional institution in this country in which psychiatry has been given an honest opportunity to do its work. There is where I join this castigation crowd. I blush as a psychiatrist for the kind of compromises that psychiatrists have permitted in connection with these opportunities. When a patient comes to a psychiatrist in his private practice and the psychiatrist determines what is needed for that patient, he does not hesitate to advise, to

prescribe, to propose and to indicate that unless these conditions are complied with nothing can be expected of the treatment. But it has become altogether too common that when psychiatrists have had an opportunity to function in an institution it became of greatest importance to be on good terms with the powers that be, and thus arises the appearance and the show of psychiatric work in institutions and little else. That does not justify extravagant opinions about what psychiatry can do. I am much in sympathy with what Dr. Gregory said concerning the danger of overselling psychiatry. I know that during the past twenty years, chiefly through the efforts of the National Committee for Mental Hygiene, the psychiatrists have largely unintentionally promised a great deal more than some of them believe they are able to deliver; but I do not regret that fact. I think that it was necessary to exaggerate, and so far as they have failed they have failed because society as a whole, the social setting in which they are obliged to function, has not been brought up to the appreciation of the fact that the job needs a certain minimum opportunity, in energy, in expense, in facilities and in time, to function at all properly. I think that before there is agitation for a change of attitude with respect to psychiatry's capacity to be of help in these matters, one ought to exploit every possible avenue of producing a better opportunity in and out of the institutions for the functioning of the psychiatrist. Then and then only will one be able to estimate what psychiatry is capable of doing in the handling of these problems.

There is another story that has not been touched on, except by Miss Additon, and that is the therapeutic aspect of this whole question. Those who are laboring day in and day out in this field know that it frequently takes months of effort to modify a simple phobia or a single obsession or to relieve a patient of anxiety. But in the clinic and the family and social welfare enterprises where psychiatrists function, significant results are expected from a psychiatric consultation lasting from a few minutes to half an hour or so. Of course, this is utterly ridiculous.

### CHICAGO NEUROLOGICAL SOCIETY

*Regular Meeting, Dec. 21, 1933*

PERCIVAL BAILEY, M.D., *President, Presiding*

Ependymoma of the Filum Terminale: Presentation of a Case. DR. I. M. TARLOV (by invitation).

This article will be published in full in a latter issue of the ARCHIVES.

EXPERIMENTAL CATALEPSY. DR. W. R. INGRAM (by invitation).

This article will be published in full in a later issue of the ARCHIVES.

TREATMENT OF MYOPATHIES. DR. HANS H. REESE, DR. E. MURRAY BURNS and DR. CAROL M. RICE, Madison, Wis.

This article will be published in full in a later issue of the ARCHIVES.

CERTAIN PHYSIOLOGIC EFFECTS OF SODIUM AMYTAL GIVEN INTRAVENOUSLY. ANNETTE C. WASHBURNE, Madison, Wis (by invitation).

A study of the effects of sodium amytal given intravenously in 350 neuro-psychiatric cases was made at the state hospital at Mendota, Wis. The purpose was to demonstrate the effects on blood pressure, pulse, respiration and sleep. The cases selected included: schizophrenia, 102; manic-depressive psychosis, 70; psychoneurosis, 60; dementia paralytica, 54; drug addiction, 20; involutional

depression, 16; epilepsy, 15, and arteriosclerotic-senile psychosis, 13. Of the total patients, 175 were male and 175 female. The patients were studied in groups of 10. Readings of the blood pressure and pulse and respiratory rates were obtained while the patient was at rest and before the administration of sodium amytal.

One gram of the drug was dissolved in 20 cc. of distilled water and injected intravenously at the rate of 1 cc. per minute. As the patient passed through the stages of hypnarcosis, readings of the blood pressure, of the pulse and respiratory rates and of the duration of the stages were taken. Stage 1 was considered as that period when the patient first noted any unusual symptoms, such as dizziness and blurring of vision; stage 2, as that period when the patient became either euphoric or drowsy, and stage 3, as that period when the corneal reflex was abolished.

Our observations revealed that: (a) The blood pressure, pulse and respiration remained fairly stable in all 350 cases during the injection of sodium amytal. There was a tendency for the systolic and diastolic pressures to fall and for the pulse and respiratory rates to rise slightly (confirming the observations of Bleckwenn and others). (b) On the average, 14.3 cc. of the solution of sodium amytal was required to obtain narcosis in fourteen and one-tenth minutes. (c) A slightly greater amount was required for female than for male patients. (d) With the exception of the arteriosclerotic group of female patients, persons with nonorganic conditions such as psychoneurosis, drug addiction, schizophrenia and manic-depressive psychosis required larger amounts of sodium amytal than did the patients with dementia paralytica, epilepsy and involutional psychoses. (e) The duration of sleep in most cases was proportional to the amount of drug given, the average being three hours and fifty minutes. (f) As an average, stage 1 was reached in slightly over three minutes; stage 2 in six minutes, and stage 3 in fourteen minutes. The duration of the stage could be prolonged or shortened by (1) the administration of more sodium or amytal, (2) the administration of a stimulant such as epinephrine, caffeine or coramine. (g) Fifty-four patients who had reached the third stage of hypnarcosis with sodium amytal were given, on the average, 5 cc. of 25 per cent solution of coramine; 12 patients were given caffeine sodium benzoate,  $7\frac{1}{2}$  grains (0.49 Gm.), and 3 patients were given epinephrine, 0.5 cc.; all the drugs were administered intravenously.

The blood pressure, pulse rate, respiratory rate and time of awakening were charted and compared with those of control groups. The systolic blood pressure rose more after the administration of epinephrine, next after coramine and last after caffeine. The pulse rate was elevated by epinephrine and depressed by caffeine. The respiratory rate was increased by epinephrine and decreased by coramine and caffeine. With all three stimulants it was possible to bring the patient from stage 3 to stage 2 in slightly over one minute. With further stimulation, the patient tended to sleep again; the period of sleep was, however, shortened.

#### DISCUSSION

DR. GEORGE W. HALL: I have employed sodium amytal intravenously in cases of skull injuries when the patient was in a more or less delirious state and required strong restraints, so that one could scarcely make an examination without quieting him. No bad effects were experienced from its use, but because of the possible dangers I wish to ask Dr. Washburne to describe her experience as to the reaction secured when the drug is given by mouth.

DR. CHARLES F. READ: What has been done at Madison in the way of producing prolonged sleep?

DR. PERCIVAL BAILEY: How long can patients be kept in the second stage? From the chart they appeared to go into and out of this stage rapidly.

DR. ANNETTE C. WASHBURN: My associates and I have used sodium amytal by mouth in doses of 3 grains (0.195 Gm.) four or five times a day, according to the condition for which the patient was under treatment. It has an excellent sedative effect, and in schizophrenia it appears to make the patients more accessible. I

do not think there is any more danger from the use of sodium amytal intravenously than is encountered when any other drug is used intravenously. I believe that if the drug is properly prepared and given at the rate of not more than 1 cc. a minute, there is little difficulty. In 350 cases, in each of which I administered the drug personally, I saw only 3 patients who showed evidences of respiratory embarrassment and this was quickly relieved by artificial respiration.

In regard to reaching the third stage quickly, this, of course, can be done if the amount of the injection exceeds 1 cc. a minute. Naturally, the time required varies with the individual patient and with the illness present. Patients with functional disease reach the third stage after a considerably longer time than do those with organic disease.

Regarding prolonged sleep, we have used sodium amytal to produce a type of psychic rest in hypermania and have been able to keep patients asleep for a day at a time, permitting them temporary awakenings; this has been helped greatly by the administration of a stimulant, such as coramine or caffeine. The length of the second stage can be prolonged as much as one desires. If the patient begins to wake up, one can give more sodium amytal. If he remains asleep too long, one can give coramine or caffeine. The chart was purely diagrammatic and did not attempt to illustrate the length of time.

HISTOPATHOLOGY OF THE CENTRAL NERVOUS SYSTEM IN EPIDEMIC ENCEPHALITIS (ST. LOUIS EPIDEMIC). DR. ARTHUR WEIL.

This paper was published in full in the June issue of the ARCHIVES, p. 1139.

DISCUSSION

DR. SIGMUND KRUMHOLZ: In the symposium on epidemic encephalitis in St. Louis presented at a recent meeting of the Chicago Medical Society, Dr. Hempelmann said that practically none of the large number of patients under his observation presented any sequelae after recovery. On the other hand, in the epidemic encephalitis described by von Economo, which is termed by some type A to distinguish it from the encephalitis of the Japanese epidemic which was termed type B, sequelae, particularly the parkinsonian syndrome, occur sooner or later in a large number of cases. However, in a small percentage of cases the sequelae set in immediately after recovery from the acute attack, and in some the parkinsonian syndrome develops even during the acute attack and persists after recovery from it.

Although the pathologic changes observed in cases in the St. Louis epidemic show a predilection as to location and cellular elements similar to that in the encephalitis of von Economo, the clinical manifestations as described by Dr. Hempelmann and particularly the absence of sequelae lead one to assume that the two epidemic types are not produced by the same virus.

DR. PETER BASSOE: I assume that as Dr. Weil did not say anything about demyelination he did not find any. Dr. Hempelmann said that none was found in the cases in St. Louis. Did Dr. Weil find streptococci in all the brains or in only a few, and has he any later information regarding the appearance of parkinsonism? I agree with Dr. Krumholz that it is strange if this syndrome has not developed in view of what has been experienced in the past. Considering the large number of cases, it is most unusual that so far no parkinsonism seems to have developed.

DR. GEORGE W. HALL: It is not yet known how long the period may be between the onset of this disease and the onset of sequelae. I think the condition is much like syphilis in that respect. One cannot estimate accurately the length of that period; it may be days, weeks or months, and I am not sure that it may not be years. Dr. Hassin has had considerable experience with these cases from a pathologic standpoint. The first case I saw was in a student at the University of Chicago; I sent the brain and cord to Dr. Hassin. His observations were almost



identical with those shown by Dr. Weil. I hope Dr. Hassin will correct this statement if I have misquoted him.

DR. G. B. HASSIN: The changes described and so well demonstrated by Dr. Weil are similar to those in the brain that Dr. Hall gave me and also in at least twenty other cases of encephalitis I have studied pathologically. I have also studied the changes in the brain in cases of typhus fever, poliomyelitis and syphilogenous diseases of the nervous system and have seen slides from cases of herpes virus encephalitis and know of the changes occurring in trypanosomiasis. In all of these conditions the changes in the brain are practically alike, including the nodules described by Dr. Weil. Had not Dr. Weil said that the slides showing changes in the brain which he demonstrated came from cases in the St. Louis epidemic, I should not have hesitated to classify the picture as that of epidemic or typhus fever encephalitis, while some changes much resembled those of syphilitic meningo-encephalitis. In other words, by looking at a slide one cannot state what type of encephalitis one is dealing with. One can say only whether it is an infiltrating or a noninfiltrating form. In the early studies of the changes in the brain in epidemic encephalitis by Dr. Peter Bassoe and me, we thought with others that they were mainly in the midbrain, especially the substantia nigra. However, this region is involved in almost every other type of infectious or infiltrating encephalitis, so the localization of the changes is not of great help in differential diagnosis. For this reason, it is not permissible to assert that the type of encephalitis in St. Louis is pathologically different from the A, B or C type, as neither the histologic changes nor their localization is specific.

DR. PERCIVAL BAILEY: It struck me that the graphs that Dr. Weil showed were not conclusive. The deaths occurred largely in the older people in other epidemics as well as in the St. Louis epidemic.

DR. ARTHUR WEIL: In regard to Dr. Krumholz's remarks, I may quote von Economo, who stated in his monograph (1929), after studying different epidemics: "This lack of systemic manifestation of combinations of symptoms bordering on the improbable gives us the possibility to establish a differential diagnosis in comparison with the rest of diseases of the central nervous system," and "it may be taken for granted that coming epidemics in the future will again bring other clinical pictures to the surface." Dr. Krumholz said that the absence of postencephalitic disease of the extrapyramidal system (parkinsonism) in the St. Louis epidemic speaks against its relationship with other epidemics of epidemic encephalitis. But, as Dr. Hall has already pointed out and as von Economo emphasized, it may sometimes be years before these symptoms develop. If the constant involvement of the nuclei of the midbrain in all the cases which I studied is assumed to exist in patients still living, one may predict such an outcome in a certain number of cases, although at present not much is known about the relationship of the clinical syndrome of parkinsonism to the pathologic lesions. It is true that the recovery of the patients in St. Louis was sometimes miraculous. I was told that in some instances, after awakening from somnolence, the patients left after a few days for their homes, having seemingly completely recovered. One should wait at least a year or longer, however, before making any prognosis as to the absence of postencephalitic sequelae.

In answer to Dr. Bassoe, I found diplococci in all cases, and Dr. McCordock, too, wrote me that he found different types of micro-organisms in his preparations. The impression was that diplococci found free in the tissues presented an agonal or postmortem infection. It was even suggested that there might be an air contamination favored by the hot summer weather and a delay in fixation. But the facts that most of the brains were removed under aseptic precautions and that some certainly were fixed shortly after having been cut speak against a generalization of the latter suggestion. One must assume that, in some cases at least, the micro-organisms were present at the time of death. Most bacteriologists have not been able to culture them, although some could, as was demonstrated by Rosenow.

In reply to Dr. Hall, I am not inclined, as a pathologist, to make any statement as to the etiologic significance of the finding of diplococci in general or in regard

to Rosenow's work. One should emphasize, however, that the histologic proof of successful transmission of the disease to animals should be a reproduction of the picture seen in man, i. e., the combination of perivascular round cell infiltration with disseminated foci of glial proliferation and not merely the finding of "generalized ganglion cell disease" or of isolated meningitis.

Dr. Hassin stated that it is not possible to differentiate epidemic encephalitis histologically from encephalitis following vaccination and typhus. Many agree with him. On the other hand, one should object to the generalized conclusion that this histopathologic picture, the combination of perivascular cellular infiltration and glial proliferation, is always indicative of a virus disease.

DR. PETER BASSOE: Were the cocci definitely located in the inflammatory area?

DR. WEIL: Until recently they were not found in the inflammatory areas but away from them. Has Dr. Hassin found streptococci regularly in the brain in cases which were not encephalitic?

DR. G. B. HASSIN: I have not looked for these organisms.

DR. PERCIVAL BAILEY: I wish to call attention to the fact that the ordinary method of fixing brains by immersing them is not adequate, particularly in hot weather. No one knows how long it takes for the formaldehyde to reach all parts of the brain tissue. At the University of Chicago, where a considerable number of brains were examined, streptococci were found in many cases in which there was no suspicion of encephalitis. That finding has been made by many others, especially by McKinley.

## Book Reviews

**Ueber den Menschenhass: Eine pathographische Untersuchung ueber Jonathan Swift.** By Adolf Heidenhain. Price, 6.50 marks. Pp. 118, with frontispiece portrait. Stuttgart: Ferdinand Enke, 1934.

A more interesting subject for a pathographic study than the great Dean Swift could hardly be found. Swift was the author of one of the best loved books of all time, dear to youthful readers, entertaining to adults, food for thought to the most mature—the immortal "Gulliver's Travels." Next to Dante's "Divine Comedy," this book is one of the greatest products of literary imagination. Its author was undoubtedly an abnormal person. Toward the end of life he suffered from an organic mental disease, but this has evidently little significance in the study of his character and work. He was governor of the Hospital of St. Mary of Bethlehem ("Bedlam") in London, and visited this institution a number of times, using his observations in his writings; e. g., "The Tale of a Tub." His considerable fortune he left (in a will made long before his own mental illness) to be used for the founding of a hospital for patients with mental diseases in Dublin. This institution (St. Patrick's Hospital, popularly known as Swift's Hospital) still exists and only a few years ago was greatly expanded.

Heidenhain has taken pains to acquaint himself fully with Swift's life and writings. In this respect he has proved himself superior to almost all previous medical writers on the subject, including Ferenczi. He gives a brief outline of Swift's life, covering a number of interesting, not commonly known, points: Swift was related by blood to the poet John Dryden; he was poor in academic work and received his B.A. "*speciali gratia*"; his uncle, Godwin Swift, suffered in old age from a type of dementia similar to that of Jonathan, etc. There is a full description of Swift's personality based on a critical compilation of evidently well authenticated data. The text contains frequent references to significant passages in Swift's various writings, many of which are quoted verbally.

In his whole interest in, and interpretation of, Swift, Heidenhain seems to have been greatly impressed by the description of the Yahoos in "Gulliver's Travels." It will be remembered that in this famous episode Swift described how the wise and civilized horses, the Houyhnhnms, have as domestic animals the Yahoos, a greedy, ugly, nude species of animals—human beings. Some of Gulliver's descriptions of the behavior of the Yahoos seem particularly appropriate for the present time; e. g., if enough food was put before five Yahoos to satisfy fifty of their species, they did not proceed to feed peaceably, as would the civilized Houyhnhnm horses, but immediately started fighting with one another violently, each wanting everything for himself. The fact that Swift describes human beings as lower than animals is interpreted by Heidenhain as a sign of Swift's "misanthropy." Similarly, Swift's bitter satire in which he suggests that the children of the poor should be killed and their flesh sold for meat is interpreted as an indication of Swift's "cruelty." Heidenhain seems to overlook here (p. 37) that this pamphlet refers to the poor Irish peasants whose misery Swift wanted to remedy by inciting them to boycott and revolt.

In his treatment of Swift's psycho-erotic constitution Heidenhain remains much too near the surface. "Gulliver's Travels," as is well known, contains some grotesquely obscene passages. Heidenhain doubts whether the "lack of normal libido in Swift can be explained more closely in any way." It is not necessary to accept all Freudian formulations to object to such unpsychoanalytic statements as "What bound Swift to Stella was not the love of the sexes, it was the affection of the father for the child, the teacher for the pupil" (p. 53). When reading of Swift's utterances and life, one is struck with the many evidences of infantilism in his make-up (so clearly manifest also in "Gulliver's Travels"), but Heidenhain does not mention this trend. He raises the question of a formal connection between

Swift's "impotence" and "coprophilia," without referring, except in a footnote (p. 77), to the well established connection between "anal" and "sadistic" tendencies, although it may well be that it is from just this angle that Swift's psychosexual constitution is best understood. Under the heading "Morality," a section is devoted to Swift's "analerotic character."

As the title of this book indicates, Heidenhain singles out as the predominant trait of Swift's personality his "misanthropy." "Misanthropy is in a way the crowning of Swift's mental personality" (p. 98). Basing his discussion on Scheler's phenomenologic studies, Heidenhain ascribes to Swift a special form of hate, an abstract hatred of human beings that is "directed against everybody and yet against nobody personally." It seems to the reviewer that—quite apart from any question of whether "misanthropy" plays such a big rôle in Swift's life and work—this particular type of "hate" is, psychologically speaking, not hate at all.

Carlyle, who understood sexual inadequacies very well on the basis of his own experience, discussed Swift under the heading "Swift's philanthropy." And he went on to make this instructive comment: "His mind was soured with indignation at what he saw around him. He took up, therefore, what was fittest for him, namely, sarcasm, and he carried it to quite an epic pitch. There is something great and fearful in his irony, for it is not always used for effect, or designedly to depreciate. There seems often to be sympathy in it with the thing he satirizes; occasionally it was even impossible for him so to laugh at any object without a sympathy for it, a sort of love for it." This statement of Carlyle comes far nearer to the core of Swift's personality than does Heidenhain's "misanthropy." It would seem that, despite the great merits of Heidenhain's book, here again—as in so many pathographies—literary critics come nearer to the truth than the physicians.

**Moderne Therapie der Neurosyphilis.** By Bernhard Dattner. Price, cloth, 22 marks. Pp. 300. Vienna: Wilhelm Maudrich, 1933.

This monograph, written by one of the assistants in the psychiatric clinic at Vienna and dedicated to his teacher, von Wagner-Jauregg, is an outgrowth of a course of lectures on neurosyphilis delivered by Dattner before American students. The book is divided into eight chapters, the first three of which embrace forty-five pages and are concerned with the technic of spinal and cisternal punctures and the method of examining spinal fluid.

The fourth chapter is devoted to the significance of the changes in the spinal fluid. Here are discussed the earliest changes in the spinal fluid in syphilis. Following the lead of Ravaut, a study is made of the earliest changes in the spinal fluid at the beginning of the secondary stage of syphilis without clinical manifestations. The author's conclusions are that an increase in the number of cells is the first abnormality of the spinal fluid; then follow an increase of albumin and of globulin, and finally the Wassermann and colloidal gold reactions. A discussion of the relationship of both negative and positive reactions of the spinal fluid in suspected syphilitic diseases is well done. Dattner stresses the fact that there may be a latent interval between the invasion of the brain and the onset of the clinical signs and symptoms.

The fifth chapter treats of the so-called spinal fluid syndromes, with a brief but complete discussion of the syndrome of dementia paralytica, that of tabes, that of cerebrospinal syphilis, the late asymptomatic positive spinal fluid syndrome and the typical spinal fluid syndrome.

In chapter 6 the therapeutic discussion begins with a complete survey of malarial therapy, as carried out in the hospital where von Wagner-Jauregg first introduced it. The contraindications, technic, methods of stopping the infection and the various complications are discussed in detail. Other methods of fever therapy are also discussed, including that in which the spirochete of sodoku is used. Chemical methods are also considered particularly with respect to the arsenical preparations. Physiochemical methods, including the use of heat, baths, diathermy and irradiation with short waves, are described. The endolumbar

methods are mentioned in passing, including the Swift-Ellis treatment. The Dercum method of spinal drainage is also mentioned, with condemnation. Combined therapy with fever, bismuth and arsenicals is considered.

In chapter 7, which occupies more than half the book, there is a discussion of the results of newer methods of therapy, preceded by quotations from many of the leading neurologists of fifteen and twenty years ago, in which it is specifically stated that up to 1922 no case of dementia paralytica had been cured. A survey of all the cases from his hospital is given under the headings of somatic, psychic and humoral changes. The results of treatment in other forms of syphilis of the nervous system are discussed, with an excellent review of the treatment of tabes, including methods of handling various symptoms separately, for example, lancinating pains, gastric crises, optic atrophy, trophic disturbances and ataxia.

The book is well prepared. It is a good condensation of all that is known at present of treatment for syphilis of the nervous system. There is an excellent bibliography. The reviewer recommends it as the best monograph on this subject in any language.

**The Mechanism of Nervous Action. Electrical Studies of the Neurone.**

By E. D. Adrian. Price, \$2. Pp. 99. Philadelphia: University of Pennsylvania Press, 1932.

Within the last decade, physiologists have interested themselves particularly in the mechanism of conduction of sensory impulses, so that a great deal of knowledge has been gained of the type of receptors in relation to a particular kind of sensation, the type of fibers conducting these impulses in the peripheral nerves and the nature of their reactions. This has been made possible by the use of specialized electrical apparatus with recording and amplifying devices, so that fairly accurate and dependable information has been gathered on which some conclusions have been based. It has been shown that, while nervous communication of all kinds is carried in the same way, by a succession of brief impulses, the impulses are not all exactly alike; those in the sympathetic system and in the smallest sensory fibers are conducted much more slowly than those in the large motor sensory fibers.

On the whole, current teaching favors the theory of specific nerve fibers for the conduction of different types of sensibility, but definite proof is lacking. It is on this problem that Professor Adrian has been working for many years, and the substance of this monograph deals with various aspects of the research.

At the invitation of the Eldridge Johnson Foundation of the University of Pennsylvania, Professor Adrian delivered a series of lectures which show that considerable progress has been made in knowledge of the subject since his previous publication, "The Basis of Sensation." Students of the physiology of the nervous system cannot well be without the knowledge to be gained from the contents of this book. The book is, moreover, an example of the sort of brevity which is most commendable in scientific publications and which is too rarely found.

**The Psychological Effects of Oxygen Deprivation (Anoxemia) on Human Behavior.**

By Ross A. McFarland. Price, \$1.50. Pp. 135. New York: Columbia University Archives of Psychology No. 145, December 1932.

Part I of this dissertation is an extensive survey of the literature on oxygen want, covering the methods of investigation, the physiologic effects, the symptoms reported by aviators, mountain climbers and miners and the changes in behavior recorded in controlled studies.

The author's own research, which is presented in part II, consists of three experiments: the first was made on nine members of the Cambridge University Air Squadron and the second and third were made on seven graduate students and psychologists at Columbia University. While breathing different mixtures of oxygen varying from 11.43 to 7.68 per cent, these subjects attempted simple choice reaction tests, formboard tests and two tests of neuromuscular control.



The author concludes that simple sensory and motor responses are not seriously impaired until the subject approaches collapse from oxygen deprivation; but that complex choice reactions are impaired relatively sooner, unless there is some strong incentive, as there was for men taking aviation tests during the war. Neuromuscular control shows great individual differences, but is usually affected before the more highly organized reactions of the choice reaction test.

Loss of memory (here estimated by performance in the formboard tests) occurs in the average subject when the percentage of oxygen is as low as 9.05. Attention and the higher mental processes are also affected, and there may be irrational or fixed ideas, failing capacity for sane judgment and self-criticism and emotional outbursts. The author presents interesting reports of cases, which seem to indicate that there are fixed reaction patterns in subjects suffering from oxygen deprivation, and that behavior under this condition correlates highly with that of persons under the influence of alcohol.

**Arteriosclerosis. A Survey of the Problem.** A publication of the Josiah Macy, Jr. Foundation. Edited by Edmund V. Cowdry. Price, \$5. Pp. 617. New York: The Macmillan Company, 1933.

The appearance of a treatise on arteriosclerosis is heartening, for to most of us (and this includes physicians as well as laymen) arteriosclerosis usually means senescence or the end of things. Therefore to have a comprehensive survey of the problem is a matter of congratulation. It is worthy of note that this research should have been initiated by a foundation, in this instance the Josiah Macy Jr. Foundation. The editing was in the capable hands of Edmund V. Cowdry, who was chairman of the Division of Medical Sciences of the National Research Council when this survey was undertaken.

The objectives of the contributors were: (1) to determine the data concerning arteriosclerosis which may be regarded as established and their interrelation, (2) to discover and to formulate definitely the principal problems awaiting solution and (3) to suggest the best means of attacking them. The editor has wisely selected contributions from scientists all over the world and it is indeed heartening to see that one of the contributors is Professor Anitschkow of the University of Leningrad; there are also contributions from Germany, France and England. The majority, of course, are from this country.

It is impossible to review a book of this kind adequately. The subject is well presented from as many different angles as it can be. It is cheering to see a chapter on the treatment of arteriosclerosis. At the end there is a useful summary, which is well and philosophically written by Alfred E. Cohn.

THEODORE H. WEISENBURG, M.D.

1876-1934

Dr. Theodore H. Weisenburg, Editor-in-Chief of the ARCHIVES OF NEUROLOGY AND PSYCHIATRY since its inception in 1911, died on Aug. 3, 1934. In life he was the very soul of this journal and to it he devoted much of his energy. To him belongs the credit for the progressive growth and present standing of the ARCHIVES. His death is a tragic blow, and the ARCHIVES will sorely miss his guiding hand. This brief announcement is an expression of the first realization of that loss by the associate board of editors and the officers of the American Medical Association, which will be shared by readers throughout the world. A more fitting tribute of appreciation of Dr. Weisenburg as a man and of his life and work is in preparation and will be published at an early date.